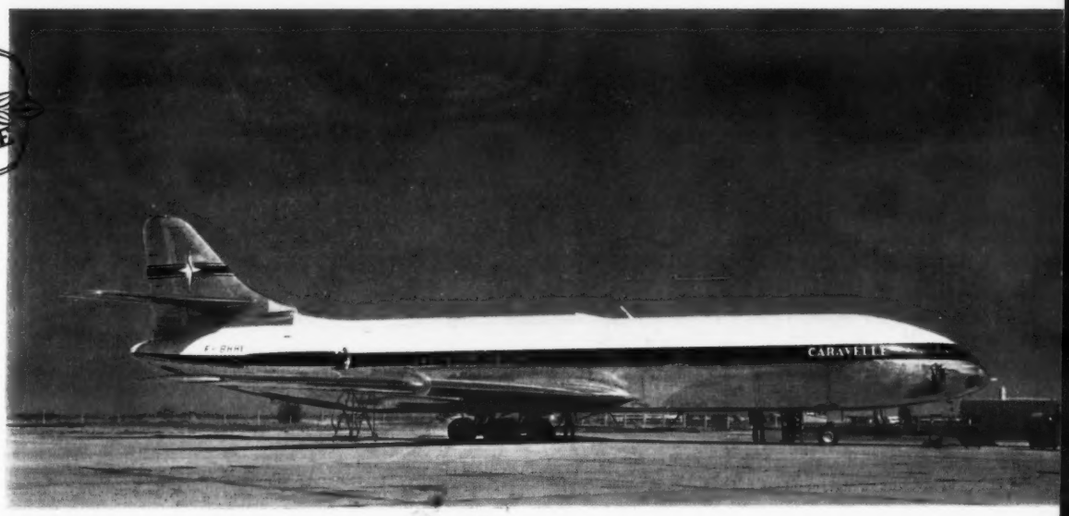
INTERAVIA

REVIEW OF WORLD AVIATION

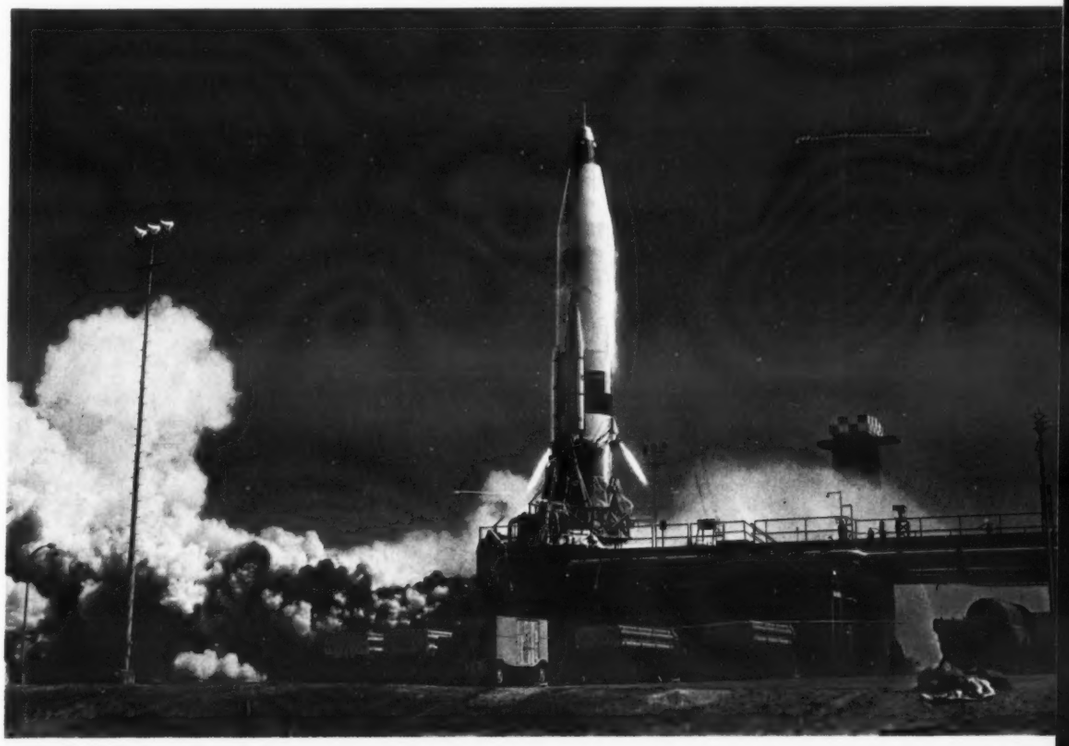
INTERAVIA 1933-1958 SILVER JUBILEE

IN THIS ISSUE



Interavia Essay Competition: Cash Prizes of $5,000

A Quarter Century of Aviation



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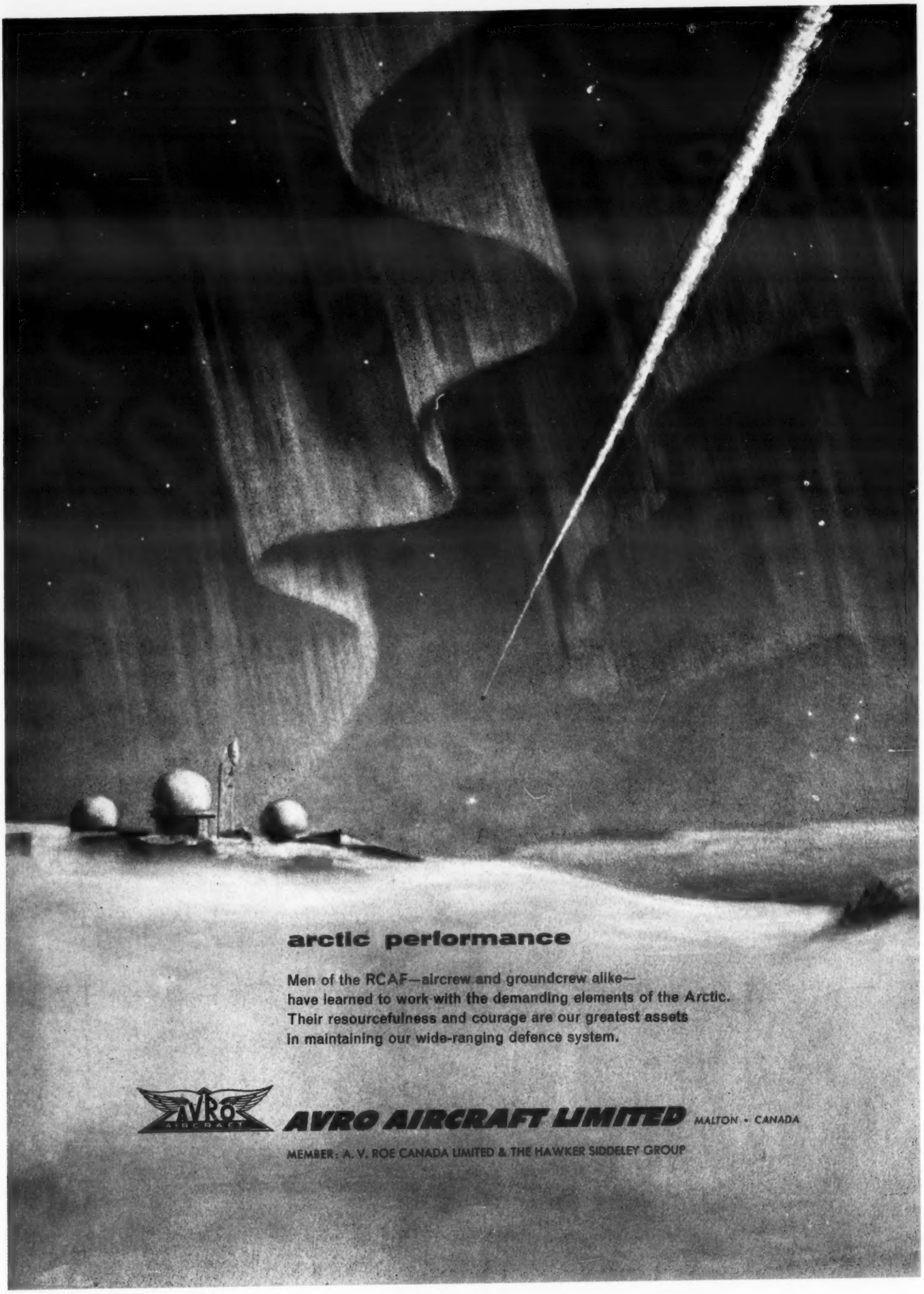
No 6 / 1958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INTERAVIA

Review of World Aviation

Volume XIII **No. 6** **June 1958**

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FRONT COVER: 25 years of development . . . culminating in the Sud-Aviation *Caravelle* jet airliner (top) and the Convair *Atlas* intercontinental ballistic missile—two designs which can be taken as symbols for the *Interavia* Essay Competition subjects.

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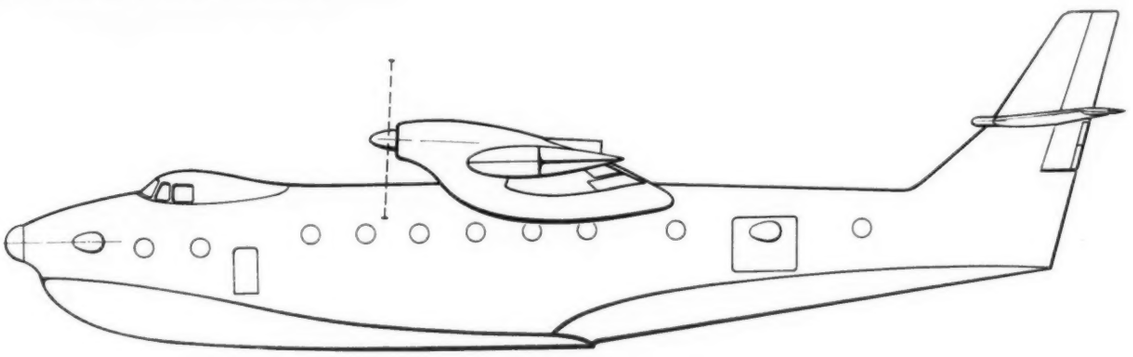
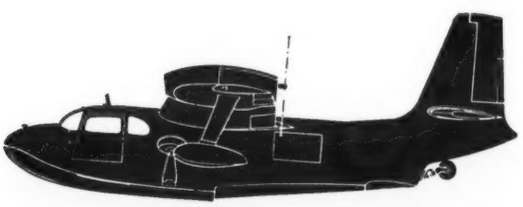
P.149-D – TOURING AND TRAINING



P.155 – MEDIUM-WEIGHT AMPHIBIAN in three versions:
Air/sea rescue – anti-submarine – transport



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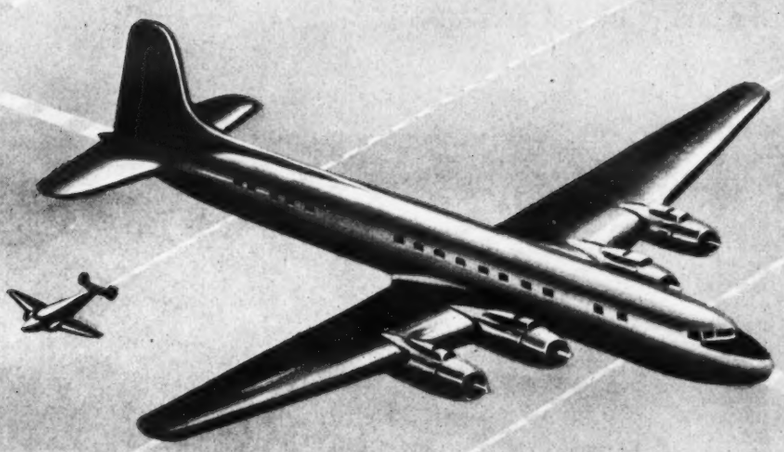

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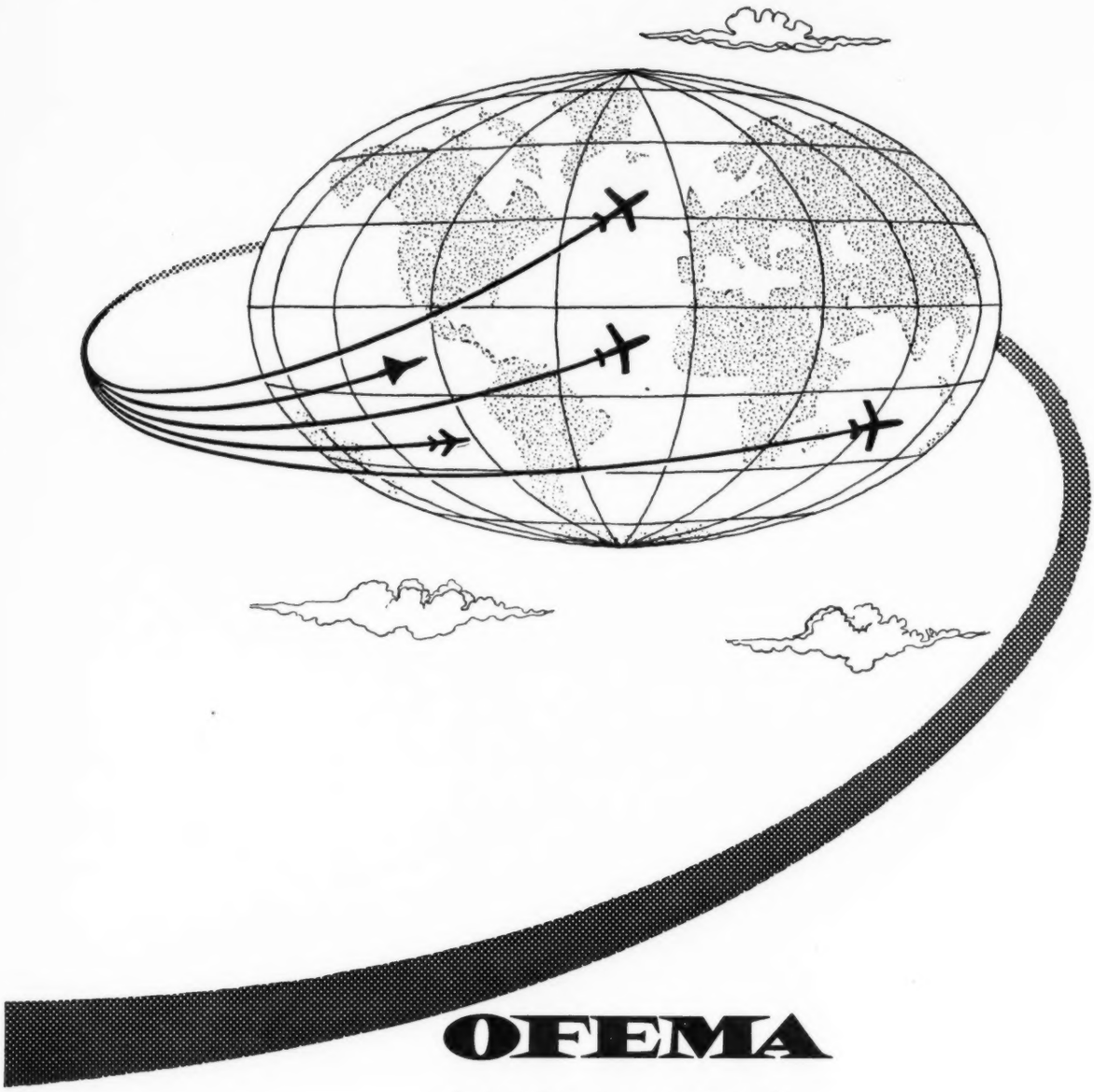

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All emergency operations up to now 100 % successful!

① Stabilizes aircraft entering webbing asymmetrically, e.g. when skidding or ground looping.

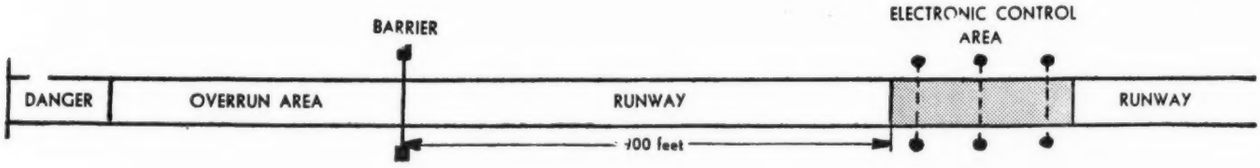
② Causes little or no damage to aircraft.

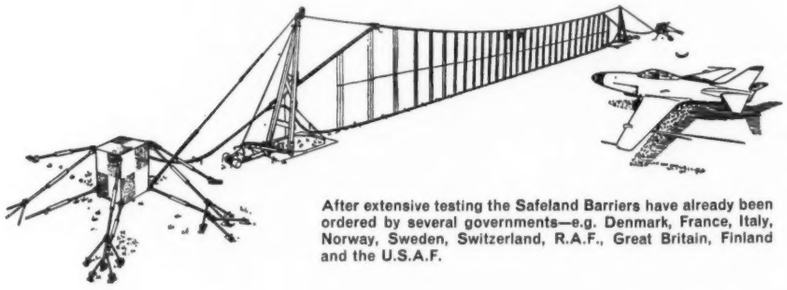
③ Additional safety in cases of pilot fatigue or other reasons.

④ No extra force on nosewheel.

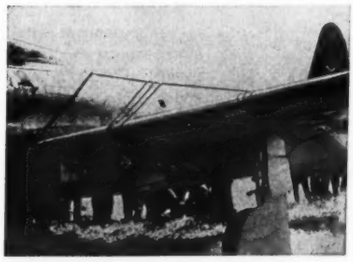
⑤ Simple rigging and easy to move.

⑥ Low purchase, installation and maintenance costs.





After extensive testing the Safeland Barriers have already been ordered by several governments—e.g. Denmark, France, Italy, Norway, Sweden, Switzerland, R.A.F., Great Britain, Finland and the U.S.A.F.



This picture shows how well and carefully the net engages the aircraft.

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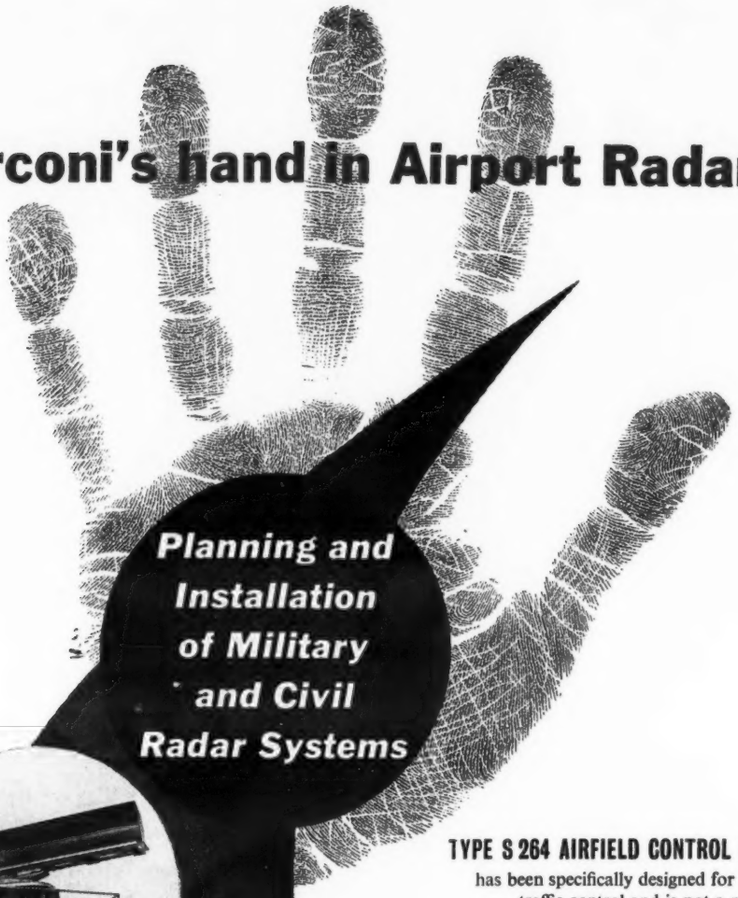
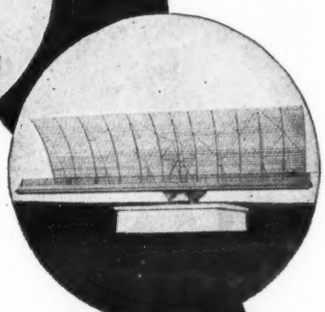
Marconi's hand in Airport Radar



Planning and Installation of Military and Civil Radar Systems

TYPE SNW 51



TYPE S264

TYPE SNW 51 3 cm STORM WARNING RADAR

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The SNW 51 provides an accurate and up-to-the-moment picture of the movement of storm centres and areas of precipitation over ranges up to 200 n. miles. Remote displays, static or mobile versions are available.

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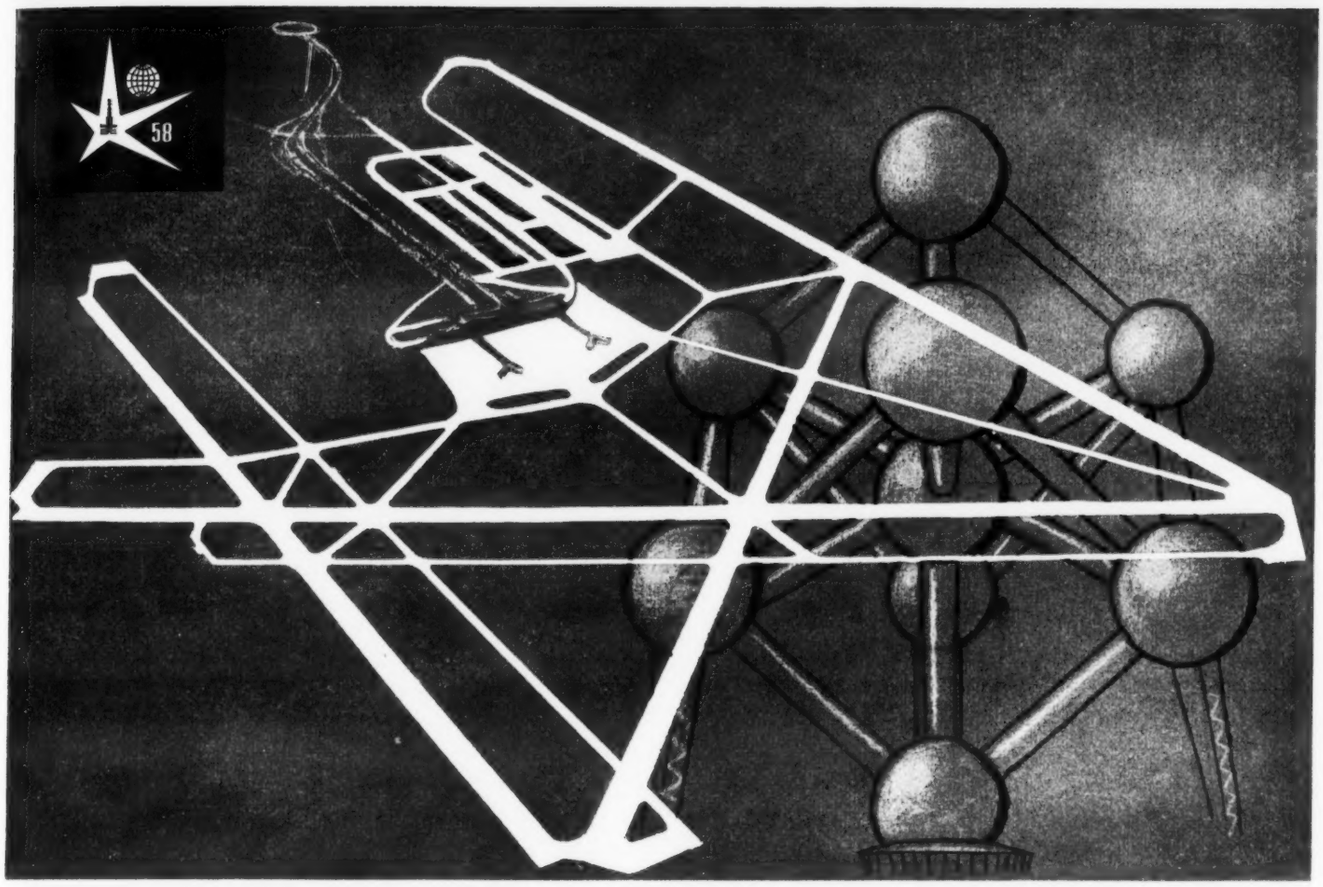

BRUSSELS 58

In 1958, to meet the increase in air traffic expected during the Brussels Universal and International Exhibition, the Belgian AIRWAYS ADMINISTRATION, as in 1949, chose COMPAGNIE FRANÇAISE THOMSON-HOUSTON to install a second G.C.A. equipment at its Brussels-National Airport.

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MILAN – Piazza della Scala 3

Comparative figures for airport traffic

AIRCRAFT MOVEMENTS

1949	1950	1951	1952	1953	1954	1955	1956	1957
Aircr. arrivals: 683	Aircr. arrivals: 1649	Aircr. arrivals: 1736	Aircr. arrivals: 2117	Aircr. arrivals: 3039	Aircr. arrivals: 4374	Aircr. arrivals: 4870	Aircr. arrivals: 5775	Aircr. arrivals: 6991
Aircr. depart.: 683	Aircr. depart.: 1649	Aircr. depart.: 1736	Aircr. depart.: 2117	Aircr. depart.: 3039	Aircr. depart.: 4374	Aircr. depart.: 4870	Aircr. depart.: 5775	Aircr. depart.: 6991
Total: 1366	Total: 3298	Total: 3472	Total: 4234	Total: 6078	Total: 8748	Total: 5740	Total: 11.550	Total: 13.982

PASSENGER MOVEMENTS

1949	1950	1951	1952	1953	1954	1955	1956	1957
Arrivals: 4951	Arrivals: 11.325	Arrivals: 19.529	Arrivals: 20.959	Arrivals: 37.606	Arrivals: 57.657	Arrivals: 74.178	Arrivals: 97.231	Arrivals: 135.242
Departures: 5564	Departures: 14.119	Departures: 18.970	Departures: 20.810	Departures: 38.173	Departures: 59.337	Departures: 76.452	Depart. 100.067	Depart.: 132.776
Transit: 886	Transit: 10.577	Transit: 18.464	Transit: 25.994	Transit: 40.751	Transit: 46.444	Transit: 52.248	Transit: 57.930	Transit: 71.412
Total: 11.401	Total: 36.021	Total: 56.963	Total: 67.763	Total: 116.530	Total: 163.438	Total: 202.878	Total: 255.228	Total: 339.432

FREIGHT MOVEMENTS

1949	1950	1951	1952	1953	1954	1955	1956	1957
Arrivals: 164.469	Arrivals: 399.096	Arrivals: 390.831	Arrivals: 396.808	Arrivals: 430.257	Arrivals: 645.048	Arrivals: 766.474	Arrivals: 1.048.389	Arrivals: 1.376.852
Depart.: 414.872	Depart.: 549.936	Depart.: 843.887	Depart.: 978.109	Depart.: 1.218.006	Depart.: 1.538.738	Depart.: 1.657.444	Depart.: 2.409.505	Depart.: 3.222.826
Transit: 13.684	Transit: 404.761	Transit: 397.432	Transit: 334.477	Transit: 395.495	Transit: 574.577	Transit: 606.317	Transit: 1.084.733	Transit: 844.989
Total: 593.025	Total: 1.353.793	Total: 1.632.150	Total: 1.709.394	Total: 2.043.758	Total: 2.758.363	Total: 3.030.235	Total: 4.542.627	Total: 5.444.667

High in the sky, power is **vital.** *Champion-equipped DC-7 gets final check before flight from Idlewild to Paris*

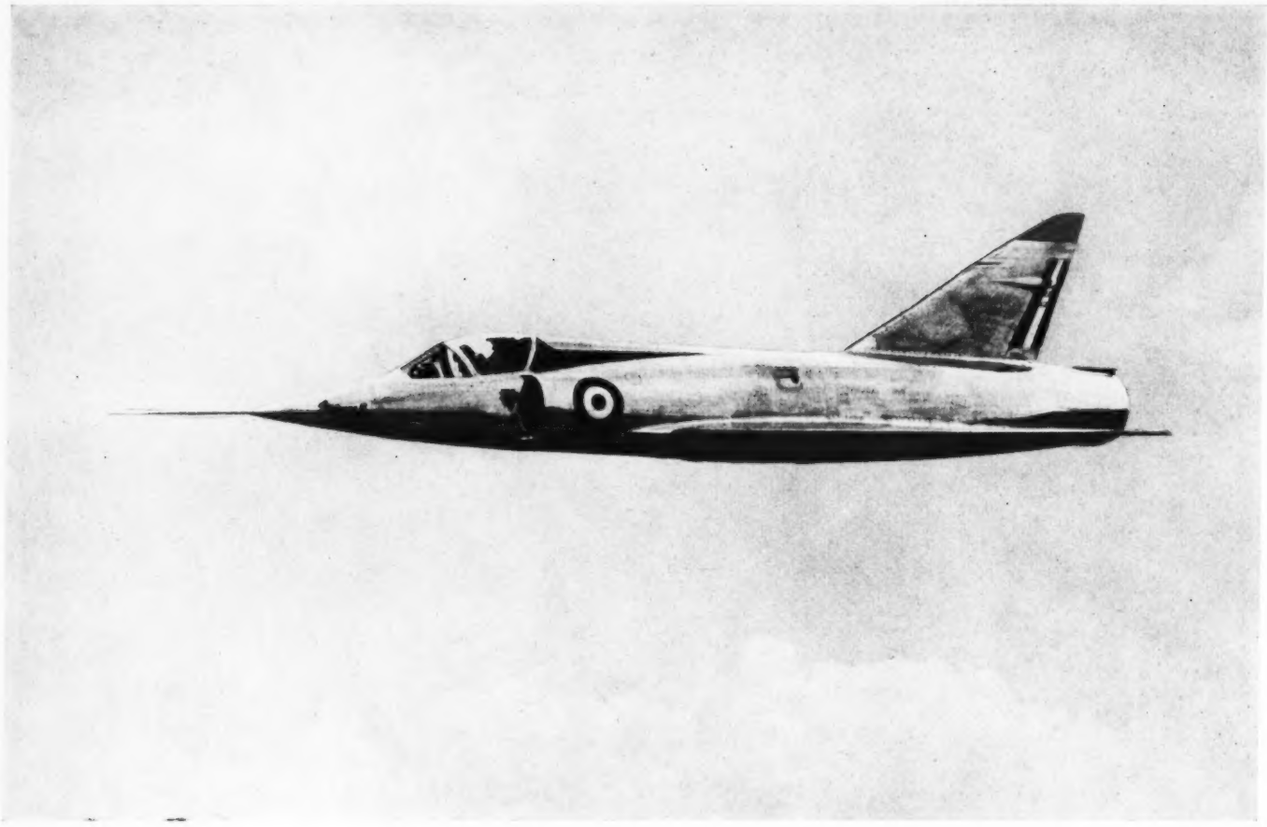
Q. Why do *all* the world's major airlines use Champion spark plugs?

A. Champions give *full-firing* power. Experience over more than a quarter of a century has convinced airline operators that Champions are unsurpassed for dependability ... power ... economy!

World's favorite spark plug on land, on sea, and in the air

CHAMPION

CHAMPION SPARK PLUG COMPANY: ENGLAND, U.S.A., CANADA, AUSTRALIA, IRELAND, FRANCE



MIRAGE III

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DEFENSIVE AIRCRAFT

GÉNÉRALE AÉRONAUTIQUE MARCEL DASSAULT

New Jet Engine Trainer now available to airlines

Link Aviation announces the availability of a unique Jet Engine Trainer that provides ground and flight crews with thorough instruction in jet engine operation.

This Trainer, which has already been ordered by United Air Lines, Trans World Airlines and Continental Air Lines, trains personnel not only in jet engine theory and operation, but in proper maintenance procedures as well.

Link's Jet Engine Trainer will give United, TWA and Continental personnel valuable, realistic experience in starting, operating and shutting down a simulated jet engine under widely varying conditions of altitude, air speed and outside temperature. Maintenance crews will gain valuable insight into repair procedures since the Trainer faithfully simulates failures and near failures—something which could not be duplicated on an actual engine without damaging valuable equipment.

The Link Jet Engine Trainer adds a new dimension to the capabilities of commercial and military aviation by providing the most efficient, most economical means ever devised for thorough jet engine training.

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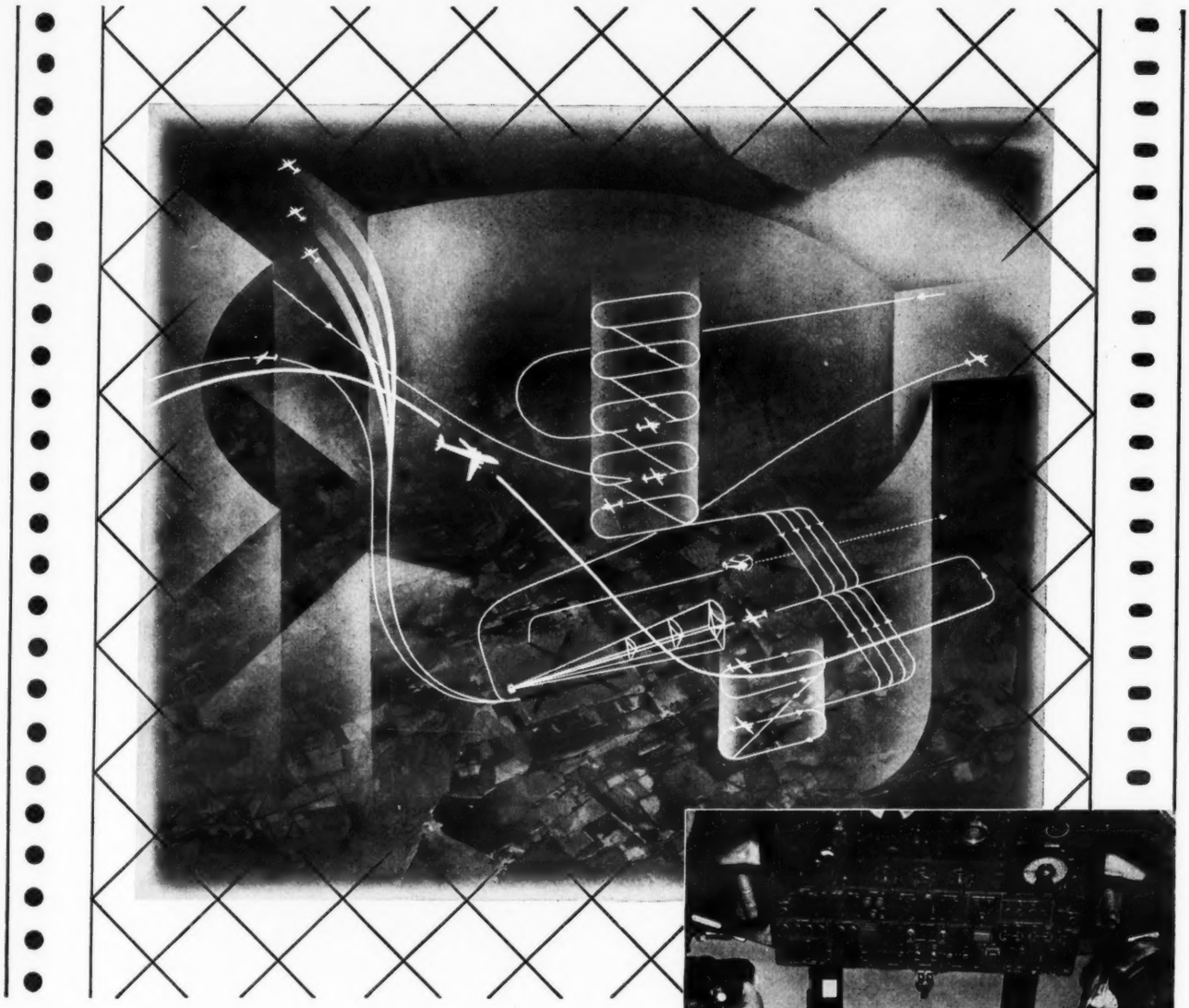
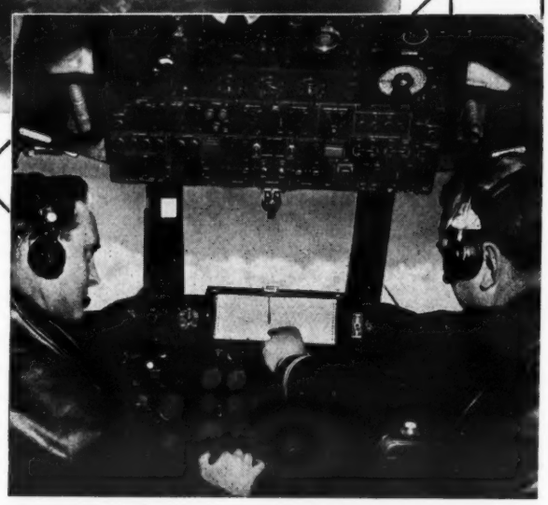


Decca in the Jet Age

As more high-performance turbo-prop and turbo-jet aircraft come into service, so the problems of Air Traffic Control become more acute. For these aircraft, precise navigation is more than ever the paramount need if they are to climb and descend safely through varying levels of medium and low altitude aircraft.

The accuracy and flexibility of the Decca Navigator, which continuously pin-points the pilot's exact position, ensures the efficient working of any traffic pattern, however complex. Holding areas can be designated and flown precisely at any altitude however high. No other aid can do this. Furthermore, no re-positioning of ground facilities is required if airways, terminal area procedures or holding patterns have to be changed for any reason.

The Decca Navigator can do much to reduce separation standards, so essential to economical use of air space. Indeed, it is the inherent precision and reliability of the Decca System that adds to the safety of high-performance aircraft, both in terminal areas and en route.



All BEA Viscounts are fitted with the Decca Navigator. Invaluable information on the requirements of jet age air traffic has been gained from over four years' operation in these aircraft.

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THE DECCA NAVIGATOR COMPANY LIMITED LONDON

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INTERAVIA

Silver Jubilee

International Essay Competition

Competition Rules

■ **Article 1 :** On June 15th, 1958, **Interavia** is opening an international contest to be known as the "**INTERAVIA Essay Competition**".

■ **Article 2 :** The competition is open to all **Interavia** readers. Members of the **Interavia** management, editorial and administrative staffs, and their families are debarred from participating.

■ **Article 3 : Essays may be submitted on one of the following two subjects :**

❶ **Air Travel for All**

How can the airlines—in particular the European airlines—make air travel accessible to the broadest sections of the population, without endangering their economic stability ?

❷ **Guided missiles or piloted aircraft ?**

Is the piloted aircraft played out, must it abdicate in favour of the guided missile, or will the two weapons continue to exist side by side for a long time to come ?

■ **Article 4 :** Essays will be accepted in English, French or German. They should not be longer than 3,000 words and must not have been published previously.

■ **Article 5 :** Manuscripts (in two typewritten copies) must reach the **Interavia** Secretariat, 6, rue de la Corraterie, Geneva, Switzerland, not later than 12 noon on December 31st, 1958. Handwritten manuscripts or manuscripts arriving after that date will not be considered.

■ **Article 6 :** The name of the author may not appear on the manuscript, which must be signed with a pseudonym. All manuscripts must be accompanied by a sealed envelope containing the author's full name and permanent address, together with the pseudonym used. These envelopes will not be opened until the Panels have made their decisions.

■ **Article 7 :** The **Panel of Adjudicators for Subject No. ❶** is composed as follows :

Honorary Chairman: His Royal Highness Prince Bernhard of the Netherlands. Members: General I. A. Aler, President, KLM; Professor A. Ambrosini, head of the Italian Delegation to ICAO, Professor of Air Law at the University of Rome; Dr. W. Berchtold, Chairman of the Board, Swissair; Don Tomás Delgado, President, Iberia; Max. Hymans, President, Air France; Basil Smallpeice, Managing Director BOAC; S. Yanagita, President, Japan Air Lines; Dr. E. E. Heiman, Managing Director, Interavia.

The **Panel of Adjudicators for Subject No. ❷** is composed as follows :

Honorary Chairman: Professor Theodore von Kármán. Members: Marshal of the Royal Air Force Sir Dermot A. Boyle, Chief of the Air Staff; Professor G. Gabrielli, Managing Director of Fiat Aviazione; Courtlandt S. Gross, President, Lockheed Aircraft Corporation; General Josef Kammhuber, Inspector of the West German Air Force; Engineer General Paul Mazer, President, Nord-Aviation; Dr. E. E. Heiman, Managing Director, Interavia.

Should any member of the Panels be unable to officiate, the **Interavia** management will appoint a substitute.

■ **Article 8 :** The decisions of the Adjudicating Panels are final, and no correspondence can be entered into.

■ **Article 9 :** The best essay on each subject will be awarded a cash prize of $ 1,500, the runner-up a cash prize of $ 1,000.

Interavia reserves all rights for publication or translation of the prize-winning essays—without payment of fees—in "Interavia Review of World Aviation" or in any other publication of its choice.

Interavia also reserves the right to publish non-prize-winning essays, under terms and conditions to be agreed with the author.

■ **Article 10 :** If in the Panel's opinion no essay reaches the prize-winning standard, the prize money will be paid into a charity, to be selected by majority vote of the Panel concerned.

■ **Article 11 :** The address given in the sealed envelope must be one at which the participant can be contacted at any time during the period of the contest.

■ **Article 12 :** Submission of a manuscript implies acceptance of the competition rules. **Interavia** can accept no liability for the loss of manuscripts, which will **not** be returned. The Geneva, Switzerland, civil courts are the only competent authority for the settlement of any disputes arising from the contest.

INTERAVIA S.A., Geneva.

Additional announcements regarding the competition will be made from time to time in "Interavia Review of World Aviation".

INTERNATIONAL MEETINGS AND CONFERENCES

June 8th-13th : Society of Automotive Engineers - Summer Meeting. Atlantic City, N. J.

June 9th-13th : 4th International Automation Exposition and Congress. New York.

June 15th : International women's aviation day. Guyancourt (S. et O.), France.

June 15th-19th : ASME - Semi Annual Meeting. Detroit.

June 15th-29th : World Glider Championships 1958 - Aero Club of Poland. Leszno.

June 16th-18th : IRE - 2nd National Convention on Military Electronics. Washington.

June 16th-30th : 5th Electronics, Nuclear Energy, Television, Radio and Cinema Show. Rome.

June 19th-28th : OSTIV - 7th Congress of the Organisation Scientifique et Technique Internationale du Vol à Voile. Osieczna, Poland.

June 20th-23rd : FAI - 9th Air Tour of Sicily organized by the Aero Club of Palermo under the patronage of FAI. Palermo.

June 20th-26th : International exhibition of parts, electronic tubes, accessories and radio-electric measuring equipment. Paris.

June 23rd : AIA - Discussion on the Aircraft Export Market. New York.

June 23rd-27th : ASTM - Exhibition of the American Society for Testing Material. Boston.

June 23rd-July 3rd : MIT - Special summer program on random vibration, an introduction to the vibration problems in missiles and jet aircraft. Massachusetts Institute of Technology.

June 24th-26th : ADMA - 31st Meeting of the Aviation Distributors and Manufacturers Association. Bretton Woods, N. H.

June 25th-27th : AIEE - Summer General Meeting, American Institute of Electrical Engineers. New York.

June 25th-27th : AIEE - Air Transportation Conference, Air Transportation Committee of the AIEE. New York.

June 27th-29th : International Air Show. Liège.

June 29th : NATO - Air Meeting and Static Exhibition. Bierset, Belgium.

June 29th-September 8th : 2nd Plastics Exhibition. Bienne.

June 30th : Airline Electronics Engineering Committee Meeting. Denver.

July 4th-6th : All American Aviation Exposition. Pittsburgh, Pa.

July 4th-8th : AAF - 12th Annual All-Woman Transcontinental Air Race. San Diego-Charleston.

July 5th : International Show and Exhibition organized by the Royal Dutch Air Force to mark its 45th anniversary. Soesterberg, Netherlands.

July 8th-11th : IAS - National Summer Meeting, Institute of the Aeronautical Sciences. Los Angeles.

July 8th-18th : MIT - Course on Fluid Power Control, Massachusetts Institute of Technology.

July 10th-12th : FAI - International aerobatics contest, Lockheed Trophy, National and King's Cup Races. Baginton Airport, Royal Aero Club of the United Kingdom. Coventry.

July 14th-15th : NACA - Triennial Inspection, Ames Aeronautical Laboratory. Moffett Field, Calif.

July 16th-20th : 7th International Air Show. Venice.

New York Finance Notes

U.S. Air Transportation and Aircraft Industry in Mid-May 1958

BY SCOTT HERSHEY, NEW YORK

The fourth month of the new year found trading on the New York Stock Exchange at 50,305,141 shares, largest monthly volume since the December figure of 54,468,183 shares. The market, after two losing sessions, rebounded to new 1958 highs on the closing days for its fourth straight weekly advance.

Airline stocks had a relatively quiet week. The industry did fairly well in the first quarter on revenues, but followed the now old story line and made a poor showing on net income. The airline story has a sameness which is familiar to all followers of these securities. A few recent headlines give the general idea : " Pan American Air Net Fell in '57 Although Revenues Set Record ", and " Western Air '57 Gross Rises but Profits Dip ", and " United Air Goes in Red in Quarter ", and TWA will show a first quarter loss.

The outlook for the domestic airlines for 1958 and beyond in the light of the CAB policies on a concept of a fair return on capital investment is not a happy one. Two developments raise serious doubts as to the continued ability of the airline industry to operate on a self-sustaining basis.

Despite the phenomenal growth of traffic in the post-war years, the level of past earnings has not permitted the airline industry to achieve the financial maturity to pay adequate dividends to its stockholders. As a result, the prices of airline shares until recently have been in a declining trend since mid-1956.

The prevailing ratio of debt to equity capital and the relationship between the current book value and stock prices makes it difficult to see how some carriers can afford to purchase all the jet aircraft they need to compete successfully in the future, unless earnings can be substantially improved by rate increases, and there is a change in the CAB policy which creates excessive competition as a result of awarding too many new routes.

A second point which raises doubt as to the ability of the airline industry to continue on a self-sustaining basis without additional fare increases is the current business decline. Airline traffic, as mentioned here before, started down in mid-September. As a result, several airlines already have lowered traffic projections for 1958.

Even prior to the recent slump in traffic, the airlines found it increasingly difficult to absorb the rising costs of fuel, labor and material. In the past seven years profits per revenue ton mile dropped about two-thirds, from nine cents in 1950 to three cents in 1957. With overhead the same, regardless of load factor, it is not difficult to see why the recent decline in traffic has cut so deeply into profits.

Of the major airlines, only seven have announced net operating figures for the first three months as this is writen. These seven had a first quarter loss of $6.27 million against net income of $687,000 a year ago. These figures speak in a voice that any investor can understand and which should be loud enough for the CAB to hear.

★

Market averages generally in April showed this range in ten aircrafts : The high was 117.51, the low, 109.56 with the last closing at 115.25, and the change from March was a plus 2.95.

In the light of this, a couple of big contractors, like North American, for example, reported net income of $12,881,000 or $1.61 a share on sales of $464,684,730 for the six months ended March 31. This compared with net income of $18,482,000 or $2.31 a share on sales of $643,175,139 in the comparable 1957 period.

J. H. Kindelberger, Chairman, said the Federal Renegotiation Board had advised the company that its determination of excess profits in the 1954 fiscal year would require a $5,500,000 refund to the Government, after taxes. Kindelberger said the company would appeal.

Mundy I. Peale, President, told stockholders the net was $702,029, equal to 48 cents each on 1,472,013 common shares outstanding. In the first quarter of 1957, earnings were $1,776,738 or $1.21 each on the same number of outstanding shares. Peale noted that the decline was predicted earlier and was due to model change-over and stretchouts on Government contracts. Republic's recent Big Board price was 22.

Richard Boutelle, President, Fairchild Engine and Aircraft, told his stockholders that the early months of 1959 should mark the beginning of many profitable years. This was good news for them in view of the fact that Fairchild has been hovering around 11, and net loss for the first quarter was $1,994,000 on sales of $28,280,000 against a net loss of $134,000 on sales of $37.237,000 a year ago.

Photo credits : Front cover : manufacturers, USAF ; pp. 523-526 : Interavia files ; pp. 527-533 : Interavia files ; pp. 534-541 : Interavia files ; pp. 542-546 : Howard Levy (2), Dr. Sänger (1), U.S. Dept. of Defense (1), Secrétariat d'Etat à l'Air, Paris (1), manufacturers (9), Interavia files (6) ; pp. 555-558 : Interavia ; p. 559 : manufacturers ; pp. 560-561 : Interavia files ; p. 562 : manufacturers ; pp. 571-574 : manufacturers ; pp. 575-576 : author ; p. 577 : Air France ; p. 578 : Deutsche Lufthansa ; p. 591 : Interavia files ; pp. 592-593 : USAF (4), U.S. Navy (2), manufacturers (4) ; pp. 596-598 : TCA (1), manufacturers (17) ; pp. 607-611 : Interavia ; pp. 615-616 : manufacturers ; p. 617 : Swissair ; pp. 618-619 : manufacturers ; p. 620 : manufacturers.

Erratum : Picture of the X-15 in No. 4, 1958, p. 328 (top): not " Interavia files ", but ATP, from " Aviation Week ".

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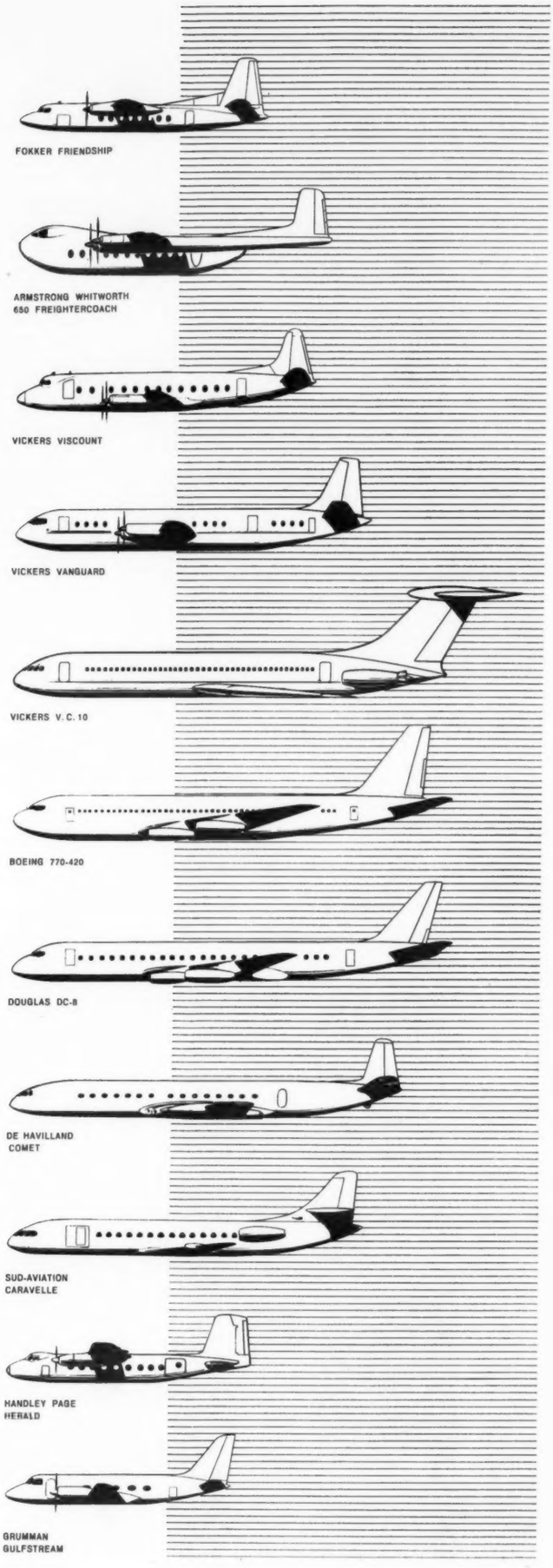

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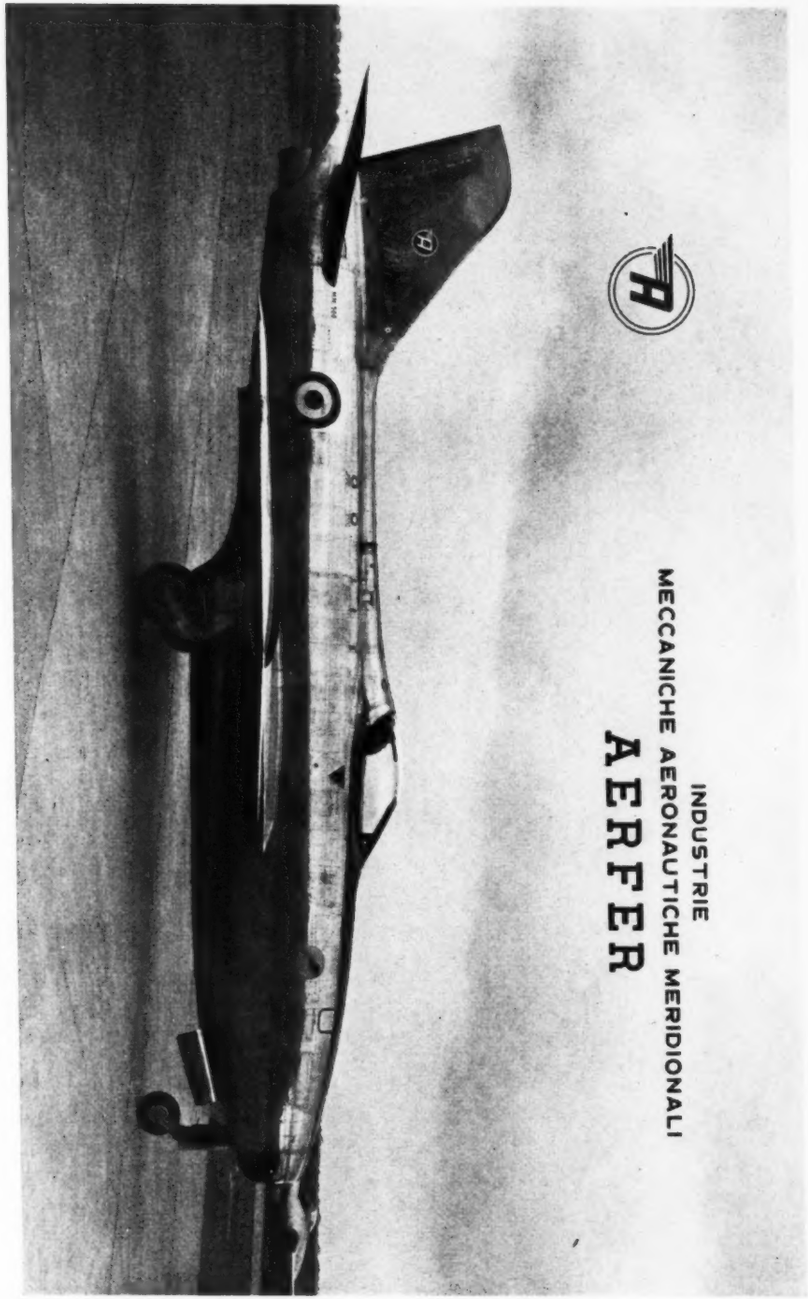

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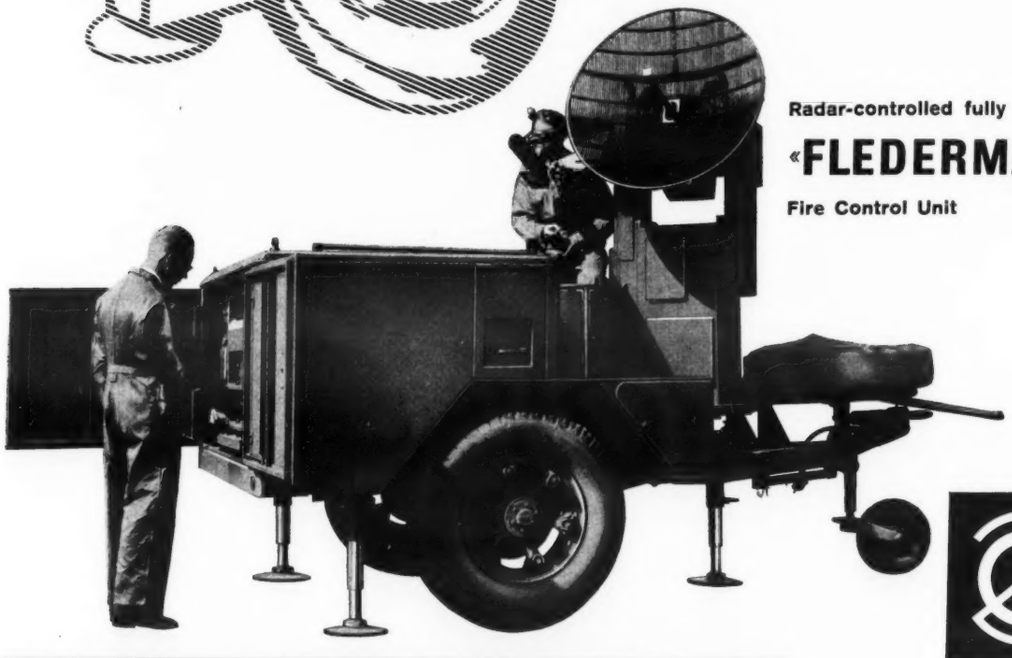

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For Hypersonic Defense

The Northrop N-156F supersonic fighter is designed to carry the latest missiles which will deliver their deadly loads at speeds many times that of sound, and are able to destroy the fastest enemy aircraft even at extreme altitudes. This high performance counterair fighter is the result of years of study by Northrop of the special requirements of allied nations of the free world. Although designed for speed in excess of Mach 2, the N-156F has not sacrificed safety of operation. Its exceptionally good flying qualities throughout its entire flight regime have been developed through thousands of hours of testing in America's most modern wind tunnels and test facilities. Its two engines assure reliability. The N-156F can be operated from small, unimproved airfields. Entire squadrons can be maintained for zero-length launch in advanced areas, scant seconds from the critical points of possible aerial combat or enemy ground targets. By using the most advanced technology, the N-156F offers this highly effective fighting power at half the total cost of procurement and operation of existing aircraft systems.

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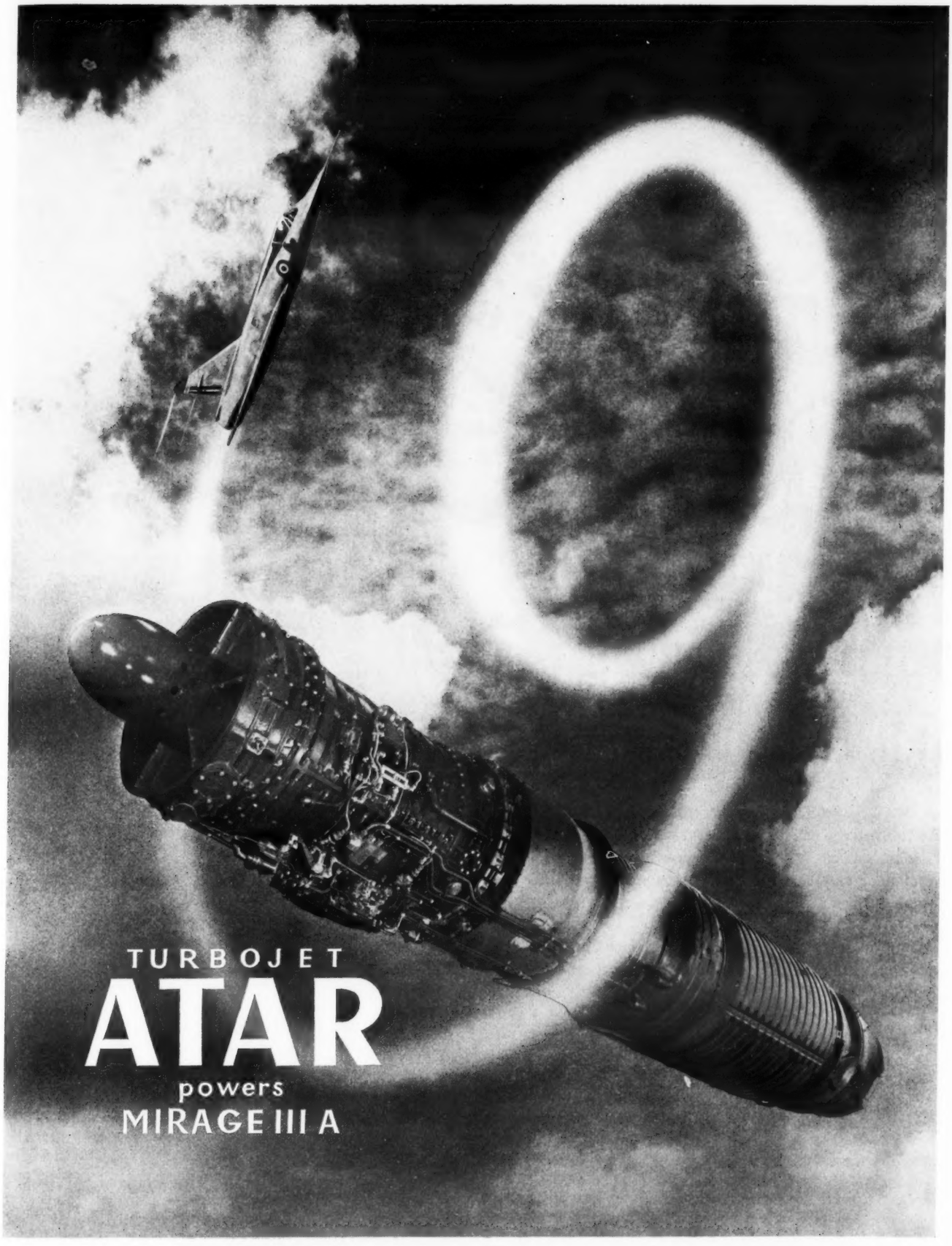

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A low cost F.S.K. Link

Plessey

Type PVR. 102 Fixed Station Diversity Radio Teleprinter Receiving Terminal for H.F.

Designed in collaboration with International Aeradio Limited. The type PVR.102 Series Terminal has been introduced to provide an inexpensive radio teleprinter receiving equipment wherever some degree of manual control is acceptable. It is particularly suitable for regional point-to-point communications and meteorological broadcasts at Airports and for Press Agency and similar work.

Owing to its low initial cost and its relatively simple installation, the terminal now offers radio teleprinter communications for use in circumstances where financial considerations have previously made them difficult to justify.

FEATURES

- Built-in metering arrangements provide for checking, setting-up and monitoring of all important circuit functions.
- Direct operation of up to three teleprinters; no relays are used, thus ensuring maximum reliability and freedom from radio interference.
- Five separate channels, each pre-set and crystal controlled. Provision of crystal trimmers ensures that frequency is exact.
- Change of channel is effected by the operation of one knob.
- Channel selector switch, can be motor-driven from the rear, thus permitting remote control. A remote channel selection unit is available.
- F.S.K. transmissions of differing shifts catered for by the use of linear discriminator, covering 200–850 c/s.
- Rapid diversity switch action on small signals differential over wide range of inputs. Complete suppression of weaker diversity signal.

A brochure setting out extensive technical data concerning the PVR.102 Series Terminal is available on request. Please ask for Plessey Publication No. 789/1.

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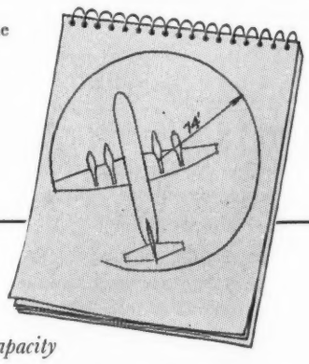
SI/1b

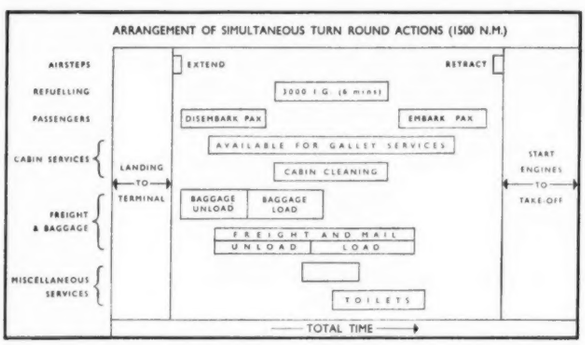
Yes, with the VANGUARD

Special design features of the Vickers VANGUARD cut time on the ground—and therefore operating costs—to a minimum. Cabin doors fore and aft, with built-in folding stairs, ensure rapid passenger handling. With their wide doors, the capacious freight holds permit simultaneous loading and unloading, and the large floor area allows spacing out of individual packages for rapid unloading at successive stops. All services are readily accessible, and the actual pressure refuelling for a 1,500-mile flight takes only six minutes. With its low tyre pressures, the VANGUARD does not have to wait to use a particular part of the apron. All this gives the VANGUARD more time where it should be—in the air! *It's the airline's airliner.*

For your notebook . . .

Minimal turning circle, and excellent visibility enabling the pilot to see both the outer engines and wing tips, mean that the VANGUARD can be taken in and out of the most crowded apron safely and quickly.





Maximum utilisation at maximum capacity

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Four Rolls-Royce Tyne Propeller-Turbine Engines

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INTERAVIA

Deadline Notes

No. 6, 1958

• **Russia's Ilyushin Il-18 Moskva** turboprop airliner is to be offered to Western customers for £680,000, according to British press reports. The price quoted is for a 98-passenger version of the aircraft. This would make the *Moskva* cheaper than the Lockheed *Electra* for which the manufacturer is asking about £750,000 ($2,100,000) without spare parts. A brochure published by the Russians lists the following advantages of the *Moskva* : 1. Unbeatable price ; 2. Quicker delivery than offered by manufacturers of any comparable Western types ; 3. Special servicing facilities for foreign airlines which undertake to operate the *Moskva* into Soviet territory. On the other hand, the overhaul life of the engines and airframe is considerably shorter, which might make operating costs higher than for the *Electra* or the *Vanguard*.

• **The first production model** of the Sud-Aviation *Caravelle*, destined for Air France, made its maiden flight on May 18th ; the airliner was piloted by M. Nadot, Sud-Aviation's Director of Flight Tests. The flight lasted 1 hour, 48 minutes and was entirely successful. The first production *Caravelle* differs slightly from the prototypes. It is fitted with more powerful engines, Rolls-Royce *Avon RA 29 Mk. 524s* of 11,000 lb. static thrust each. The fuselage has been lengthened by 13.7 inches, and this has made it possible to extend the cabin which will have 64 seats in 16 rows, each with window. The engine nacelles have been lengthened to house thrust reversal equipment (to be fitted later) and to reduce fatigue. The airliner will be delivered to Air France at the beginning of next year and is due to be put into service in the spring of 1959. Together with the second production model which is now being completed, model No. 1 is due to make a number of test flights before the autumn to obtain the French and United States Certificates of Airworthiness. In addition, two more *Caravelles*, without engines or equipment, are undergoing static tests at the Toulouse works ; and at the Saint Martin du Touch facility a number of *Caravelles* are in various stages of production.

• **The first batch of 150 Super Mystère B2** one-place aircraft, powered by an *Atar G* turbojet engine, is nearing completion. The production rate for this aircraft has been cut down from eleven to nine per month because of financial restrictions. Deliveries to the French Air Force have begun. A second series of 100 aircraft is envisaged.

• **The Breguet 940** experimental aircraft made its first flight on May 21st at Villacoublay. The flight lasted 15 minutes. The Breguet 940 is a short take-off aircraft to be used for experimental purposes.

• **De Havilland Aircraft** has reorganized and streamlined its after sales and service organization to meet the potential requirements of *Comet 4* customers. The de Havilland Aircraft Servicing School has developed a new *Comet* Systems Trainer for BOAC. This allows air crew and ground crew to familiarize themselves with *Comet* systems and to practise normal and emergency actions without taking up valuable time on the Air Trainers flight simulator now on order. BOAC air and ground crews are already being trained at the school at Hatfield ; and the school is preparing for the training of crews for Aerolineas Argentinas and British European Airways. The 14 *Comets* belonging to BOAC, the RAF and the RCAF have now logged 15,000 hours of flying, the majority of it within the past year. BOAC's 19 *Comet 4s* are expected to average about 4,000 flying hours per year, the equivalent of an 11-hour flying day. The time available for aircraft maintenance is, therefore, limited, so that ease of maintenance becomes even more important. Experience and theoretical studies confirm that *Comets* require fewer servicing man hours per flying hour than the contemporary piston engine airliners. An important aspect of the Service Department work is the advice and assistance given in preparing the Approved Maintenance Schedule, which is a mandatory certification document. This basic schedule is devised so that it can be tailored by the Service Department to suit the special needs of individual operators ; from it advice can be given on a Planned Maintenance and Overhaul System adapted to the operator's fleet. To reduce the work involved in the routine inspection of the aircraft structure the Department, in conjunction with the Company's central laboratory, has developed an X-ray procedure which is both economical and simple.

• **Orenda Engines Limited,** Malton, has signed a programme of technical assistance with Bayrische Motoren-Werke of Munich — the company designated by the West German Government to repair and overhaul Orenda turbojet engines which power the Canadian-built *Sabre* aircraft of the German Air Force. The programme will include the training of BMW personnel both in Germany and at the Orenda plant in Malton, and assistance in setting up procedure and in the purchase of some capital equipment. Orenda will supply the necessary tooling. Spare engine parts will be supplied from Orenda's Malton plant when BMW's repair and overhaul programme gets under way. E. Whittering has been appointed as Resident Technical Representative from Orenda Engines at the BMW plant and is already in Munich.

• **Air Vice Marshal A. M. Engineer's** appointment as General Manager of Hindustan Aircraft (Private) Ltd. in succession to J. M. Shrinagesh has been announced in Bangalore. Air Vice Marshal Engineer was previously Deputy Chief of the Air Staff.

• **Breakfast in Moscow ... dinner in New York :** Sabena and Aeroflot have agreed to pool their services between Belgium and the Soviet Union. With effect from June 2nd, two flights a week in each direction will be operated between Brussels-Melsbroek and Moscow-Vnukovo (one by Sabena and one by Aeroflot). From August 1st, Sabena intends to operate a second weekly service, while Aeroflot plans additional flights for the months from June to October. Sabena will use DC-7 Cs, and Aeroflot Tu-104As. Fares will be as follows : Tourist class 10,375 Belgian francs (approx. $207) single, return 18,675 francs (approx. $373) ; first class — single 11,215 francs (approx. $224), and 20,190 francs (approx. $405) return. At Moscow, the services will connect with flights to Peking and the Far East, whereas at Brussels, connections will be made with Sabena flights to New York.

• **Aviameer Airlines SPRL,** a new charter company with headquarters at Antwerp-Deurne Airport and administrative offices at 26, Rue Osy, Antwerp, has put its first aircraft — a Vickers *Viking 1B* — into service. The company was founded on October 31st, 1957, and its purpose is to engage in the transport of passengers and freight by air, sea and land, to represent airlines and shipping lines and to charter and hire aircraft. The General Manager is Alfred Meerbergen, with Paul Hazelof as Sales Manager. The new company has opened offices at both Antwerp-Deurne and Melsbroek.

• **Frédéric Filliol,** for many years Swissair Public Relations Chief in Western Switzerland, has been appointed Executive Vice President of Donald A. Stiess International Public Relations in Geneva. He will assume his new duties on July 1st.

The Stiess organization is acting as European public relations consultant to Douglas Aircraft Company. Filliol's successor as Swissair's Public Relations Chief in Geneva has not yet been appointed.

• **The Australian Government** has approved the purchase of four Lockheed *Electras* for Qantas Empire Airways, two for Ansett-ANA and two for Trans-Australia Airlines, and firm orders have now been placed. Approval has also been given for the acquisition of three *Electras* for Tasman Empire Airways, the company jointly owned by Australia and New Zealand. Trans-Australia Airlines has been given permission to order an additional six Fokker F.27 *Friendships*.

• **Costa Rica** became the 73rd member state of the International Civil Aviation Organization on May 31st, thirty days after its instrument of adherence to the Convention on International Civil Aviation was deposited.

• **The U.S. Army** announced on May 20th the establishment of a highly mobile force for instant use in local conflicts. Designated the Strategic Army Corps (STRAC), the new force is made up of two airborne and two infantry divisions trained and equipped for swift movement to jungle, Arctic and other possible battlegrounds. Equipment includes medium-power atomic weapons. The full manpower strength of STRAC is 50,000 and the new force is commanded by Major General Robert F. Sink, paratroop commander of the 82nd Division at Fort Bragg, North Carolina. A series of field exercises is to be held by STRAC over the next few months in the United States, Panama, Alaska and Europe. Air mobility for " Fire Brigade " forces has also been the preoccupation of the British Armed Services. Last February, the Royal Air Force and the British Army held a two-day exercise in Libya to see how quickly men and equipment could be rushed to a presumed trouble spot. Like the British Army units, the Strategic Army Corps is dependent on the Air Force for air transport.

• **Preliminary negotiations** have been completed for the purchase of Westrex Corporation, a wholly-owned subsidiary of Western Electric Company, by Litton Industries Inc., a joint announcement by the two companies states. The purchase price is not disclosed. The two companies are working out the details of the transaction, including a patent licence agreement. The purchase will bring to the Litton structure an international marketing organization of some 1,300 employees with 35 offices in foreign countries. Westrex distributes and services abroad a line of communications products, including Teletype, and equipment for the motion picture industry. Litton Industries specializes in the manufacture of computers, data processing equipment, communications and navigation apparatus, business machines, microwave tubes, and electronic components. With 17 domestic manufacturing plants and research laboratories and a plant in Amsterdam, the Litton organization employs some 8,500 people and has its headquarters in Beverly Hills, Calif.

• **Commonwealth Aircraft Corporation** is reported to be investigating the market for a short-haul " bush " airliner, with modified *Wasp* engines, *Interavia's* Melbourne Correspondent reports. The project, for an original design, is in its earliest stages, but CAC believes that Australia has a need for at least 30 such aircraft, and that South East Asia would offer a bigger market.

• **Professor Willy Messerschmitt's** aircraft design office and Messerschmitt AG have concluded an agreement on close collaboration in the fields of research and development. Under the terms of the accord, the design team of Prof. Messerschmitt's Technical Office will be incorporated in the Messerschmitt AG company. Prof. Messerschmitt will be in charge of all development work.

• **The new Gatwick Airport** is to be officially opened on June 9th, 1958. Gatwick, which will be used initially for British European Airways' Channel Islands services, by several independent air transport operators, and as the main bad weather alternate for London Airport, is intended to be Britain's new air gateway to the Continent. The first stage, costing about £7 million, will be completed this summer. The second stage, to be undertaken when the need arises, will involve substantial expansion of existing buildings, the erection of additional buildings and the construction of a second runway.

Workshop Briefs

● The code name for Britain's 2,000-2,500 mile range IRBM has now been revealed as *Blue Streak*. Another British weapon with a ballistic trajectory has been revealed as *Black Knight* ; no details are available.

● Reports indicate that development of a civil version of the Orenda *Iroquois* high performance jet turbine is planned. The military version of the *Iroquois* is destined to equip the Mark 2 version of the Avro *Arrow* twin-jet supersonic interceptor, and with afterburner develops a thrust of 28,000 lb.

● *Aerojet-General's* 15NS-250 rocket engine has been awarded a CAA Type Certificate. This new 250-lb. thrust, solid fuel engine is specifically designed for standby use, singly or in multiples as required, on single and multi-engined aircraft up to 10,000 lb. gross weight.

● The new SE.116 *Fonceur* two-seat support aircraft (two 650 h.p. Turboméca *Bastan* turboprops) has been re-named the *Voltigeur*. By the time these lines appear, the SE.116 will probably be undergoing flight testing. The aircraft has a low-set wing and conventional tail unit, a span of around 59 ft., a length of 41 ft. and a cruising speed in the region of 243 knots.

● The first Dassault *Etendard IVM* single-seat combat aircraft, for the French Fleet Air Arm, is now in final assembly. Power is supplied by a SNECMA Atar 8 of 9,700 lb. thrust.

● On May 16th, 1958, Walter W. Irwin set up a new world speed record of 1,404.19 m.p.h. in a Lockheed F-104A *Starfighter*, which is about 200 m.p.h. faster than the previous record of 1,207.6 m.p.h. held by a McDonnell F-101 *Voodoo*. The F-104A also holds the world altitude record of 91,249 ft. (cf. " What's in the Air ? " elsewhere in this issue).

● The first pre-production model of the Dassault *Mirage III A* supersonic interceptor commenced flight testing at Melun-Villaroche on May 12th.

● The Air Ministry states that it is shortly to make a decision on the long-range freighter for RAF Transport Command. The choice will be between a *Britannia* development, a *Vanguard* development, and the Blackburn B.107.

● It is practically certain that the first prototype of the *Dassault Méditerranée* small transport will be powered by turboprops (originally jet powerplants were planned). Two Turboméca *Bastans* will be installed buried in the wings. The aircraft will have a gross weight of more than 11,000 lb., a range of 1,350 nautical miles, and will fly at a cruising speed of 290 knots. The project for a *Méditerranée* with two Turboméca jets has not been abandoned.

● There is still no decision on the number of engines to be fitted to the *D.H.121 for BEA*. Discussions on the rival merits of three- and four-engine layouts in the tail are continuing. The design is not finalised, and both the *Olympus* and the RB-141 (or RB-142) are under consideration.

● *Pluto* is a joint U.S. Army and Navy project for the study of high-altitude parachute recovery of solid propellant rockets in vertical trajectories. Several experiments at Mach 4 have been made with stainless steel mesh parachutes. The object of the project is the recovery of instrumental payloads and the post-operative examination of the rocket combustion chamber.

● Short Brothers & Harland Ltd., in conjunction with English Electric, has developed an unmanned version of the *Canberra* jet bomber, designated *Canberra U Mk. 10*. The fully automatic jet aircraft will be utilized for testing new guided weapons systems and is particularly suitable as a target aircraft.

● The U.S. Navy has announced that a new rate of climb record has been set up by the Douglas F4D *Skyray* delta jet interceptor. The aircraft climbed to 3,000 meters in 44.39 seconds, 6,000 meters in 1 min. 6.13 secs, 12,000 meters in 1 min. 51.23 secs and 15,000 meters in 2 min. 36.05 secs. There was no previous record for this last climb.

● Captain E. L. Beeding, USAF, has withstood *accelerations of 83 g* for one tenth of a second without protective equipment during tests on a rocket sled. During the test he sat upright, facing backwards in a rocket sled chair, which was halted abruptly by water brakes.

● General Electric Company is believed to have developed a ducted fan engine, known as the *X220*, from the J79.

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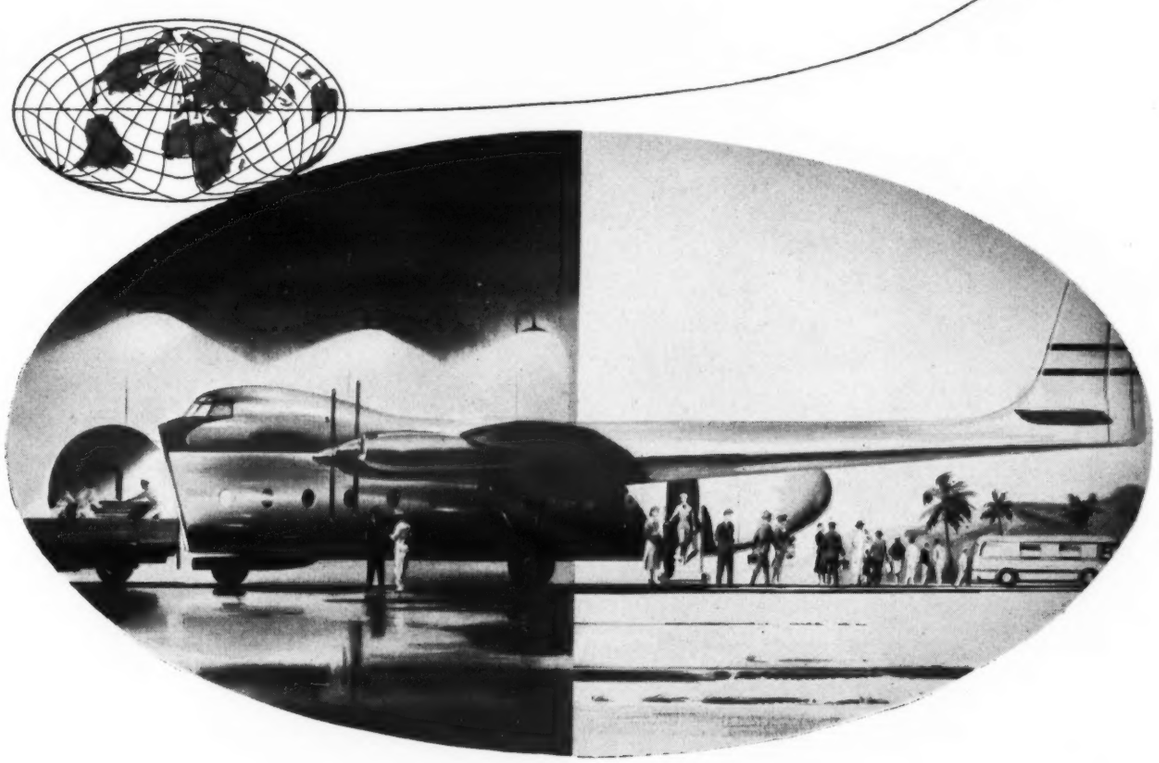

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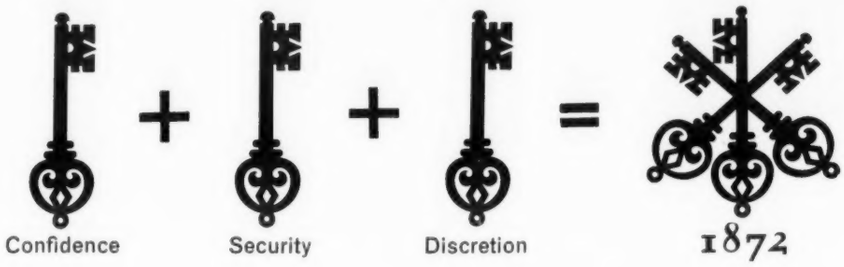

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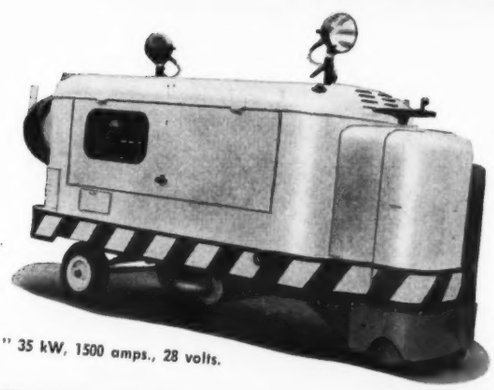

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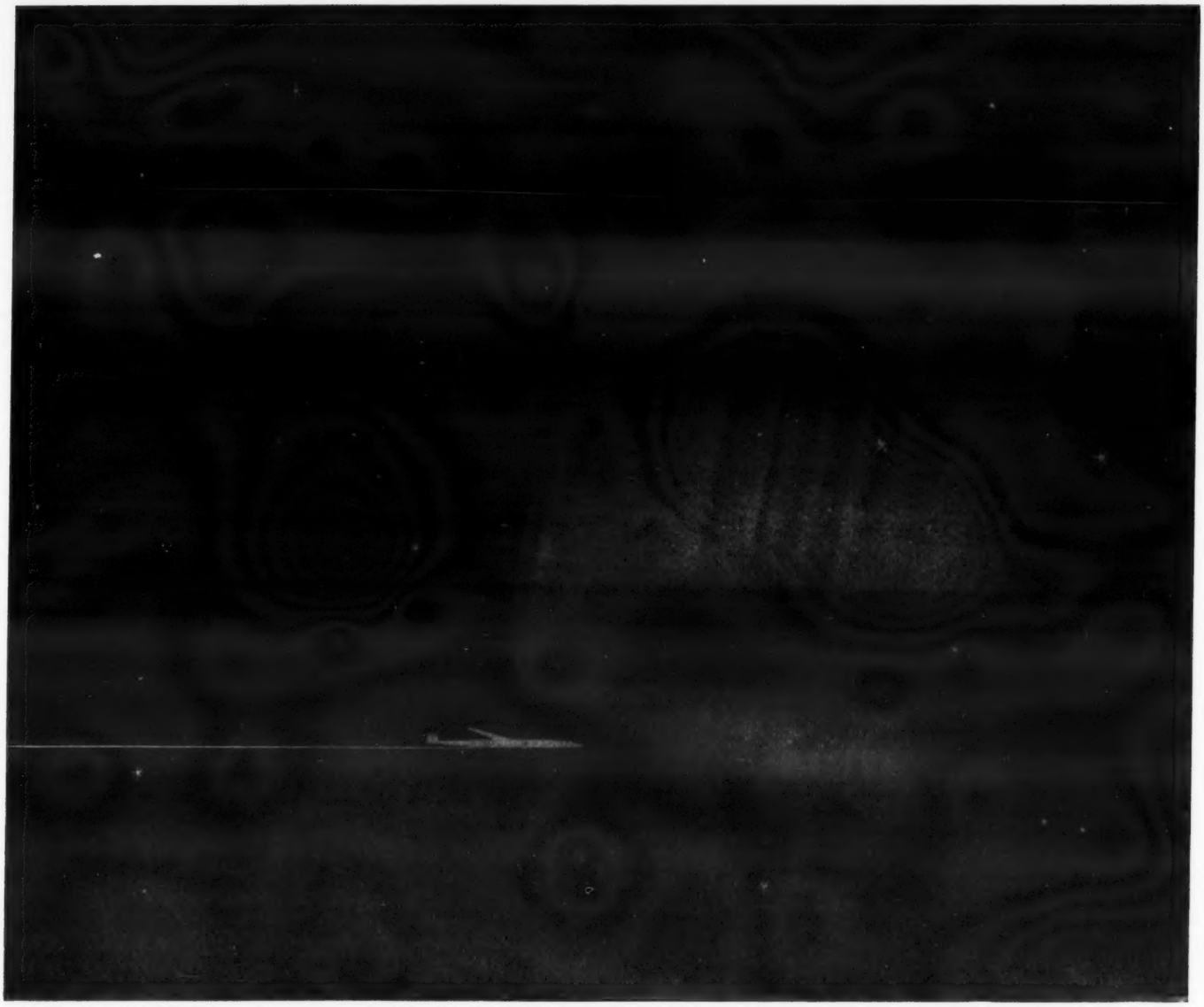

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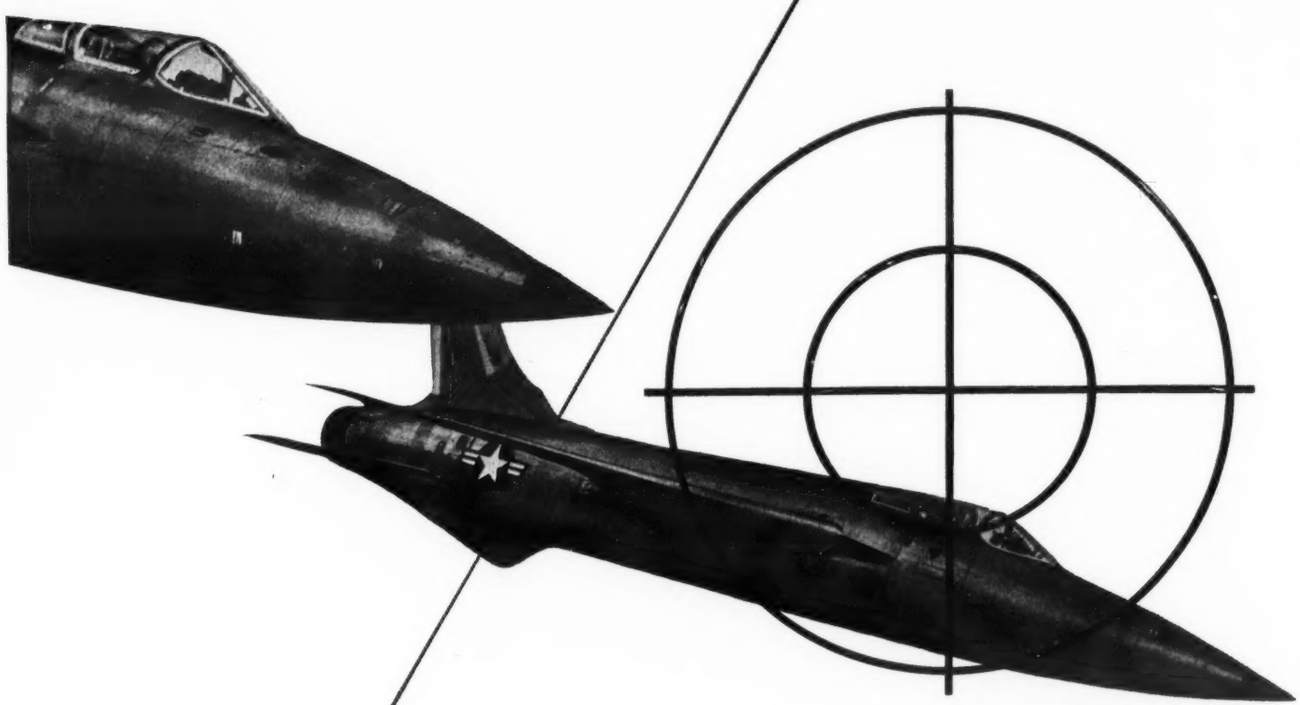

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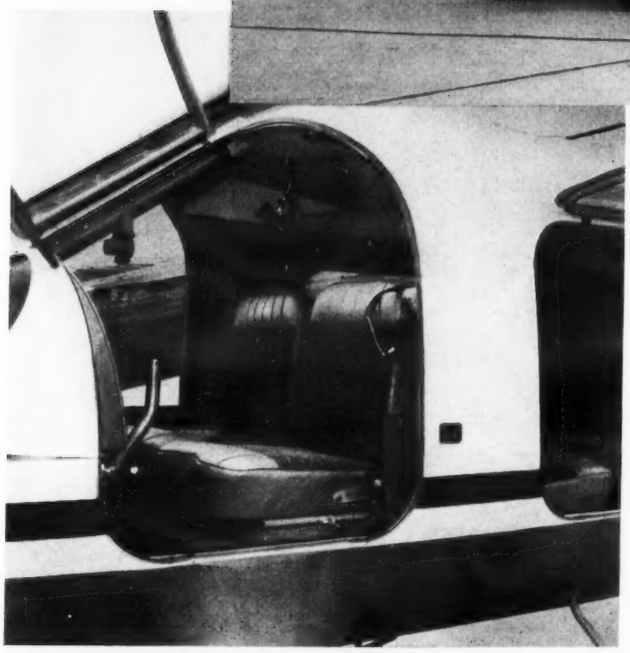

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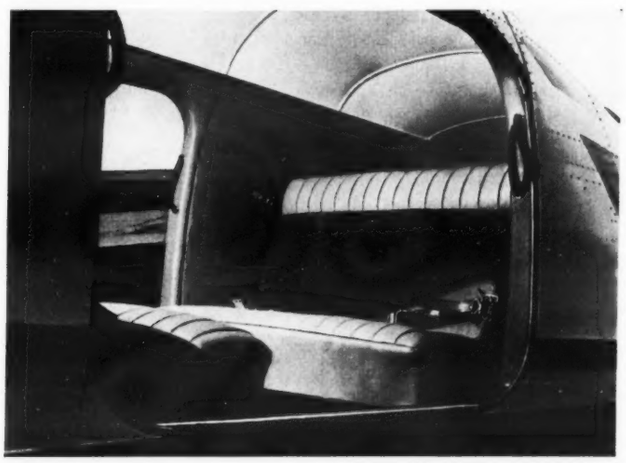

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Military transports: NORD 2501 Noratlas, BREGUET 765 Sahara
Communications aircraft: MORANE-SAULNIER 760 Paris, Max HOLSTE 1521 Broussard
Trainers: FOUGA 170 Magister, MORANE-SAULNIER 733 Alcyon
Civil transports: SE.210 Caravelle, BREGUET 763 Deux-Ponts, NORD 2502 Noratlas
Air work: HUREL-DUBOIS H.D.34
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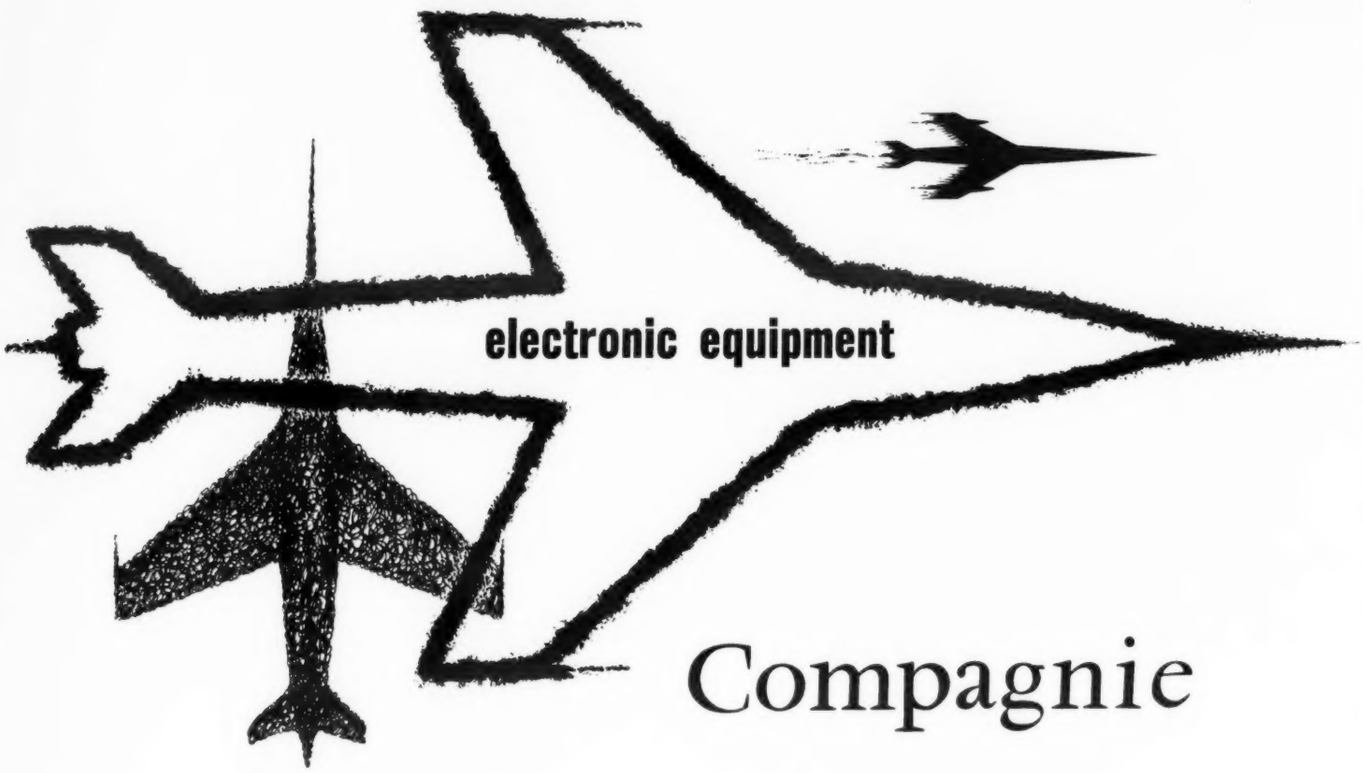

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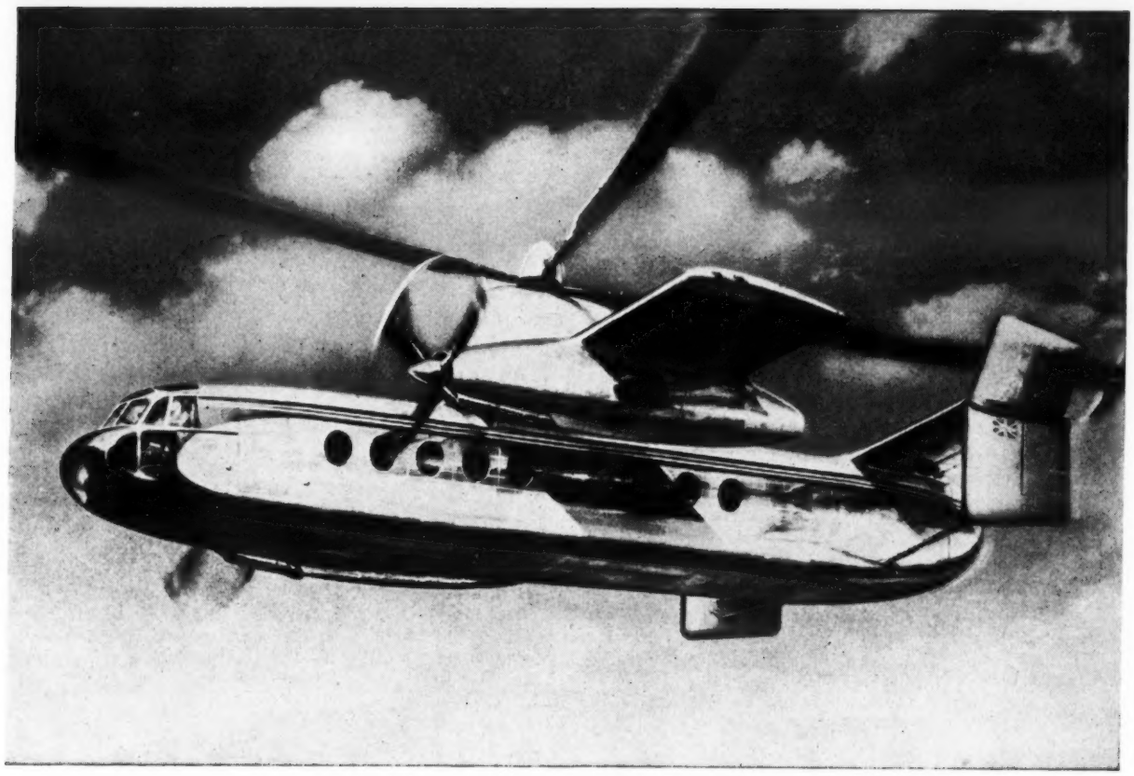

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Carrying 48 passengers or 4½ tons of freight it takes off vertically as a helicopter and having gained height flies forward as a normal twin-engined airliner.

It is the most adaptable rotary-wing aircraft in the world and the first to offer operating economy directly comparable to that of fixed-wing aircraft over ranges of up to 400 miles.

The arrangement within the Rotodyne's capacious fuselage can readily be adapted to suit civil or military applications.

Powered by two Napier Eland propellor-turbines with Fairey Pressure-Jets at the rotor-tips for take-off and landing.

FAIREY *Rotodyne*

48 passengers · 185 m.p.h. cruising speed

400 miles maximum range.

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ENGLAND · AUSTRALIA · CANADA

FOR ITS FUTURE DEVELOPMENT POSSIBILITIES...

The ENGLISH ELECTRIC P.1B is one of the most advanced fighters in the world. Even so it is clear that the basic design has further great potential development—not only in performance, but also in adaptation to other operational roles. This built-in stretch offers economies of production and operation, as well as ensuring that, tactically speaking, it can be adapted to meet any situation which may arise.

..THE P.1B IS INCOMPARABLE

'ENGLISH ELECTRIC' aircraft

THE ENGLISH ELECTRIC COMPANY LIMITED · MARCONI HOUSE · STRAND · WC2

INTERAVIA 1933-1958 SILVER JUBILEE

A Personal Message to our Readers

"Looking for an American aviation man in Europe? Chances are you'll find him in Geneva... Slowly, steadily and for good reason, this leisurely city has become the European headquarters of the American aviation industry... Of the 70 or so American companies in Geneva, more than 30 are in some way connected with aviation... And the city has become so important for the industry that 'Aviation Week'—probably the world's most authoritative magazine in its field—now has its main European office here. Geneva, incidentally, is also the editorial and production headquarters of 'Aviation Week's' European counterpart—the glossy, four-language 'Interavia' magazine..."

These words are from the December 1957 issue of "The American Abroad", published in Paris and Geneva. Incidentally, to repay the compliment, "The American Abroad" is a very readable and well illustrated publication. The December issue did not reach our desk until April, and we have not yet had the pleasure of meeting Michael O'Halloran, the author of the article.

The reason why we have used his sentences at the head of this page is that *Interavia* is a living witness of the developments which have taken place in the old League of Nations city on Lake Geneva during the past quarter century.

When we inaugurated our first publication, "Interavia International Correspondence on Aviation"—which has been published without a break and is now appearing daily in the form of "Interavia Air Letter"—on April 3rd, 1933, we were, so to speak, alone in the wilderness. Even then, of course, in good weather Mont Blanc could be admired from the right bank of the Lake, whose shores were as inviting as today, and the "bise noire"—the biting wind which comes down from the northeast—is still with us. But as regards aviation, Geneva's small airport at Cointrin was by no means a gateway to the world. In good weather a single-engine Air France aircraft or a Lufthansa three-engine Junkers might land there; or Walter Mittelholzer, the Swiss national air hero and early Board member of Swissair, might create a sensation with some strange-looking American design which, to all appearances, could have been either a fighter-bomber or a civil transport. We knew quite well why *we* had elected Geneva as headquarters of our company, and during the past 25 years the virtues of the city have been recognized not only by our American friends, but also by such conservative firms as Rolls-Royce, who are also represented here.

To put it briefly, *Interavia* celebrated its 25th anniversary in April this year. Like the airlines, we started in a small way and have lived through good and bad times. Today we realize that both have been invaluable.

In our fast-moving age a quarter of a century is no long period. We could have celebrated April 3rd, 1958, with a big party, but after the usual hangover such parties are quickly forgotten. So we have decided on a different scheme, which is not particularly original, but which may perhaps serve a better purpose:

The present issue is devoted to the history of the past 25 years during which aviation has grown out of all recognition and has incontrovertably become a factor in world politics and world economy. Today aviation seems to have arrived at a new turning point, after the past 25 years of steady growth. We are therefore organizing a modest *Essay Competition*, in which we hope that our readers throughout the world will participate. We are offering *cash prizes totalling $5,000*, for answers to two problems which are of immediate concern today to the airlines, to military aviation and to the whole aviation industry: Firstly, *how to fill the turbine-powered aircraft which will shortly be introduced alongside the existing piston-engine types?* and secondly: *Will the missile really oust the manned aircraft, or can the two weapons continue to exist side by side?*

For the judging of these two contests, we have succeeded in obtaining the cooperation of two panels of adjudicators composed of leading personalities in their fields, and full details of the competition will be found elsewhere in this issue. We are certainly not conceited enough to imagine that our efforts will provide the final answer to questions of such burning importance, but we hope to meet with the same response and enthusiasm among the younger generation which led us 25 years ago to devote almost the whole of a working life to aviation questions.

Our readers themselves will be able to judge of our success or failure during these years. For our part we should like to seize this opportunity of thanking the tens of thousands of men and women of all tongues and all continents who have remained true to us for 25 years. For once, the cloak of anonymity is lifted from *Interavia*'s editorial and administrative staff, who now introduce themselves, and undertake to continue to give of their best.

Geneva, May 1st, 1958 INTERAVIA

A quarter century

1933 - 1958

Interavia Celebrates its 25th Birthday

Dr. E. E. Heiman, founder of Interavia S. A., Managing Director and Editor-in-Chief.

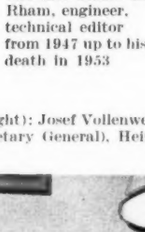
Marcel Devaud, industrialist, former Central President of the Aero Clubs of Switzerland, Board Chairman of Interavia since 1942.

Colonel Edgar Primault, former C.-in-C., Swiss Air Force, President of the Swiss Watch Manufacturers Association, Vice-President of Swissair, Interavia Board member.

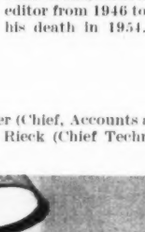
Eugen Groh, of the Swissair management, Interavia Board member since 1949.

The late Colonel Emil Messner, former Central President of the Aero Clubs of Switzerland, Vice-President of FAI, 1933 – 42 Board Chairman of Interavia.

The late Colonel Arnold Isler, Commander-in-Chief of the Swiss Air Force in 1919, founder of the Federal Air Office in 1920 and its Head until his death in 1941, father of Swissair, who played a leading part in the establishment of Interavia.



The late André de Rham, engineer, technical editor from 1947 up to his death in 1953



Jean Jenni, French editor from 1946 to his death in 1954.

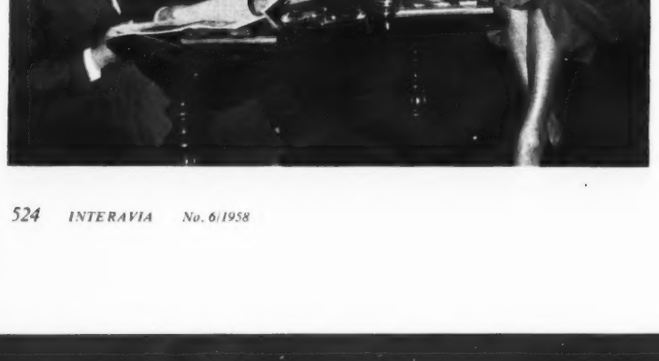
"Aviation? – You must be out of your mind if you are seriously considering joining that world of bicycle mechanics and hopeless cranks . . . There's no money in it, and socially they're nobodies . . ." Such was the encouragement I got from my friends when, in Paris in 1927, I decided to launch the first multi-language "Guide Aéronautique International".

Chance had brought me into contact with a number of personalities from the French air transport industry, and I had seen that aviation journalism was strictly limited by national frontiers and national languages. There were already, of course, several serious aviation publications, such as Henri Bouché's "L'Aéronautique", "The Aeroplane", edited by the humorous and witty C. G. Grey, and Edward P. Warner's excellent "Aviation". But really international papers were non-existent. If a pilot of those days wished to find details, in his own language, of foreign airports or airways, he had to use the slow-moving "official channels" of his ministry or national authorities, and was not always certain of success. So I set about compiling a volume giving in three languages (French, English and German), basic information about air traffic regulations, prohibited areas (so common in those days), airports, etc. This tome appeared at the end of 1928 and, surprisingly enough, it was successful, even financially. As sometimes happens, the novice had hit the jackpot.

Meanwhile in my new activities I had got to know a great many people who, like myself, were young, enterprising and imbued with an indestructible faith in the future of aviation. I can still see Albert Plesman in his modest office in The Hague, on the first floor of No. 9 Hofweg; in his outer office hung a model Fokker aircraft, and tickets were sold to a few intrepid air travellers. Next to Plesman sat Hans Martin, probably the real creator of the East Indies service. How well I remember the modest beginnings of the old Deutsche Lufthansa in Lindenstrasse, Berlin, under the triumvirate Milch, Wronsky and von Gablenz. I was deeply impressed by Major Woods-Humphrey, whose Imperial Airways was generally believed to be more powerful than it really was. And the visitor to France's Aéropostale in the Champs-Elysées felt – as it turned out later, not entirely correctly – almost as if he were entering the gold vaults of the Banque de France.

The world's leading air power in those days was the *République Française*. She was in the lead both politically and militarily, with her half

Interavia Management (left to right): Josef Vollenweider (Chief, Accounts and Administration), Henri Schwamm (Secretary General), Heinz Rieck (Chief Technical Editor), Pia Russak (Advertising).



Editorial meeting (left to right): Klaus Regelin (Technical), Peter Hausheer (Air Letter), Philippe Lapierre (French editorial staff), Erwin Herzfeld (Air Transport and Aviation Finance), Ernst Naschke (Electronics), Eduard Baur (Technical).

dozen airlines she was the pacemaker in the air transport field, and her industry was the biggest exporter of aviation equipment. Somewhere further back Italy was also stirring, with Italo Balbo as an outstanding pioneer. The British with their Empire had the monopoly of bases in all corners of the earth, and could decide who should fly where. But from time to time the others took their revenge. Today it appears laughable that the first British Empire air service to India, operated by Short flying boats, started not for instance from Southampton, but from the Italian port of Brindisi. The French and Italians had refused permission for the British aircraft to fly over their territory. Passengers therefore travelled to Brindisi by rail. But this is by the way.

Although I was very happy in Paris and was so to speak at the centre of the aviation world, I gradually realized that the heart of a major air power was not the place for the supra-national publication I had in mind. I knew Switzerland, had been there as a student in earlier years, and in Berne my professional travels had brought me into contact with Colonel Arnold Isler, the father of Swiss aviation. I was on friendly terms with Walter Mittelholzer and Balz Zimmermann, the directors of the future Swissair. My inquiry as to what Berne's reactions would be to the establishment of an international aeronautical publishing house in Geneva was well received.

Such was the beginning of *Interavia,* and April 3rd, 1933, saw the publication of the first "blue pages" which are today distributed throughout the world under the name of "Interavia Air Letter". We opened up with a staff of four, with assistance from friends and from time to time good luck.

One piece of good fortune was that my old friend Tony Fokker found me my first correspondent in the United States. Immediately after World War I Fokker had founded Fokker Aviation in North America, which cost him many a grey hair, but which was later to develop into General Aviation and today's North American Aviation Inc. As he still had interests in the United States he employed a permanent representative on the West Coast, who was instructed to work for me too. His name was Richard Mock. I had never met him, but he must have had plenty of spare time, as he wrote daily reports averaging ten typewritten pages and accompanied them with copious photographic material: the first retractable undercarriages, the first automatic pilots, the first variable pitch propellers, all of which were more or less new to us Europeans.

Another stroke of luck came when, through Colonel Isler's recommendation, I engaged my first technical assistant, then a fair-haired youth, today a respected colonel on the Staff of the Swiss Air Force. We sat together day and night going through the mass of reports from all over the world and sifting the wheat from the chaff. The result was published twice a week in moderately good German, English, French, Spanish and even Italian. At the beginning readers were rather few and far between, but word of our efforts soon got around, and from 1935 onwards our subscription list grew by leaps and bounds. We had so to speak broken new territory, we were the first to write about the Douglas DC-1 or the small ten-seat Lockheed *Electra,* and had even involved Fokker in heavy costs through our talkativeness. He found himself obliged to buy the Douglas and Lockheed licences, a step which paid off both for him and for the manufacturers. For me, however, it was a blow, as I lost my West Coast correspondent, who became Fokker's man with Douglas—still a relatively small company. But Mrs. Mock took over until her baby was due, when Richard's brother Elliott stepped in. At any rate the Mock family is still among my friends. Richard Mock is today President of Lear Incorporated, his charming wife has kept her youth, and Elliott Mock is a well-known figure at Boeing.—So it all began . . .

Space limitations prevent me from listing all those who have been associated with me during the years, but I must at least mention Dr. Giorgio Lourier who, as a very young man, was detailed to work for us by Italo Balbo and who has represented our interests in Italy ever since. Georges Février, *Interavia* Manager for France, joined me 24 years ago; today he is also President of the French Aviation Writers Association and President of the Fédération Internationale des Journalistes Professionels de l'Aéronautique. Both Février and Lourier have stood by us in fair weather and foul.

Meanwhile the *Interavia* family was growing almost from year to year. The first edition of *Interavia ABC* international reference book came out in 1936. Everything seemed to be going fine . . . but War was approaching.

When it broke out we already had quite a respectable crew in Geneva and why deny it—had gained an international reputation. The Swiss on our staff were of course mobilized, but came and helped out from time to time at weekends, and a small nucleus remained intact. At first we

Editorial staff (left to right): Prof. Angel Arbex (Spanish edition), Manuel Altimiras (Spanish edition), Jean-Charles Burki (French edition), Jean-Sylvestre Cosandey (ABC), Jean Didelot (ABC).

English-language Editors (left to right): Gordon Ruddick (Review), Jutta Turkova (Air Letter), Joan Stroud (Head).

Administration (left to right): Jules Richter (Dispatch Manager, with the Company since its foundation), Madeleine Bertholet (Accounts), Marc Marthaler (Circulation Manager), Gilbert Gassmann (Subscriptions).

Production executives: Oswald Fischer (Printing Manager, left), Willy Mahrer (Art Editor).

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Foreign Editors and Representatives

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scarcely knew whether or how we could continue, but we were determined to try. And it is with a certain sense of satisfaction that I now re-read what I wrote on September 5th, 1939:

"*He who reads this bulletin in the hope of finding war communiqués, lists of aeroplanes shot down, accounts of destruction and similar items, will vainly scan its pages . . . For seven years this publication has done its best, within the means at its disposal, to advance and foster aeronautics. While this task has not always been an easy one even in normal times, it seems today, at the dawn of a war in Europe, almost insurmountable. But we shall make the attempt. Is it not now doubly the duty of the countries not directly involved in the conflagration to hold aloft the torch of progress? Within our limited scope we shall take our share in protecting this sacred flame . . . With this idea in mind we now get our first war issue on its way.*"

When the war was approaching its climax in 1943, we wrote:

"*The Editors of these pages are of the opinion that they should not only talk of Stalingrad, North Africa, the Battle of the Atlantic, but also of problems that will recur in the coming years of peace, namely the civil air services.*"

And we continued to give air transport its full share of our attention.

How we managed to get our pages out in those days was sometimes a mystery even to ourselves. We had no secret sources of information, but Switzerland's neutrality offered the advantage that we could from time to time obtain newspapers and magazines from the belligerent countries, when they were not intercepted by the censors. Everything we did receive was carefully studied, and we tried to read between the lines. Sometimes we were very wide of the mark, sometimes we hit the bulls-eye and found our statements confirmed a few days or weeks later. So it went on . . . We had our problems, but enjoyed our work. I must frankly admit that I have had the good fortune of gathering a real elite around me in the course of the years.

Commendatore Dr. Giorgio Lourier (Rome), representative in Italy since the company's foundation. (picture 1)

Georges Février, Officer of the Legion of Honour (Paris), head of Interavia France, representative in France for the past 24 years. (picture 2)

Derek H. Wood (London), London Editor and head of Interavia U. K. Ltd. since 1953. (picture 3)

Colonel (Retd.) Wolf Eberhard (Bonn), head of Interavia Verlags-GmbH., Germany, since 1954. (picture 4)

Henk A. Jansen (Amsterdam), representative in Holland since 1951. (picture 5)

Roger F. J. Gillyns (Antwerp), representative in Belgium since 1954. (picture 6)

Sven Walberg (Linköping), representative in Scandinavia since 1937. (picture 7)

D. Luis Saenz de Pazos (Madrid), representative in Spain since 1946. (picture 8)

Fernando Herdade (Lisbon), representative in Portugal since 1958.

Max. W. Morstadt (Vienna), representative in Austria since 1955. (picture 9)

Harry Tennant (Washington), Editorial Director USA since 1954. (picture 10)

Norman Lynn (Los Angeles), West Coast Editor since 1955. (picture 11)

Charles E. (Bud) Soden (New York), Advertising Director USA since 1955. (picture 12)

James C. Galloway (Los Angeles), in charge of business interests on the West Coast since 1957.

Mrs. May Willmot (Don Mills/Ontario), wife and successor to Ross Willmot, representative in Canada since 1953. (picture 13)

J. K. Chilwell (Johannesburg), representative in South Africa since 1955.

Nobuo Matsumura (Yokohama), representative in Japan for the past 24 years. (picture 14)

Kenneth Green (Melbourne), representative in Australia since 1954.

Wing Commander R. Vaughan-Fowler (Bombay), representative in India since 1954. (picture 15)

José Villela (Mexico City), representative in Mexico since 1956.

After the war we launched "Interavia Review of World Aviation". In what seems to be a tradition of our company, we started it at a critical period, as we had done our first publication in 1933. That we now have other publishing plans will probably come as no surprise. But more of that another time. *EEH*

25 Years of Air Transport

Assessment for the future

By Sir William P. Hildred, Director General,
International Air Transport Association, Montreal

There could be no more fitting way of introducing a survey of air transportation during the past 25 years than by passing the word to one of the world's most competent authorities. Sir William P. Hildred built up the new International Air Transport Association after the war and has developed it into a factor of world-wide importance. He had previously won his spurs as Britain's Director-General of Civil Aviation. Editors

Twenty-five years in civil aviation is a long time—almost half the life of powered flight itself and two-thirds the span of air transport as we know it.

Looking back at 1933 in the perspective of 1958, it seems even longer still. The shapes, the numbers, the characteristics and, alas, even many of the faces of air transport have changed almost beyond recognition.

There are, however, certain things that have not changed. Our hopes for air transport still remain unbounded. Our accomplishment, though substantial beyond the dreams of a quarter century ago, still lags behind those hopes. And because of this gap, the challenge of air transport remains as great as ever.

Since the past is only prologue to the future, I do not intend to dwell on what has happened to air transport in the years since *Interavia* began recording its progress. Those who have been with it through those years need no reminders: those who have joined it since the war (and they are now the majority) will consider me hopelessly nostalgic. Suffice it to say that I do not consider that there are any really valid bases for comparison between air transport as it was then and as it is today. The technological changes wrought by wartime development, the statistical increases in every measurement of air transport—whether it be horsepower, speed, route miles, passenger kilometers, eggs consumed by catering departments, or millions of investment—have all been too vast.

What is important, to my mind, is to use the measure of the past to determine what we want for the future. Here, I think, there is a very close correlation, because essentially we still want the same things.

First and foremost, as ever, we want safety. Development to date has guaranteed us a very good level of safety in our day-to-day operations, but only when we accept certain operating limitations which translate themselves into economic penalties. We must therefore look in future for reduction of these operating limitations without loss and, indeed even with a gain, in overall safety.

This, of course, implies a need for improvement in two directions—in the aircraft itself, and in the devices and procedures of air traffic control. For the immediate future, I believe that the emphasis must be on the latter, for the aircraft with which we are re-equipping today must, because of their relatively enormous capital cost, continue to serve us for a decade or more to come, without any radical change in type and probably with little more than a gradual improvement in present characteristics.

Now I shall not stipulate any detailed aims here; and in any event, the overall requirements for air traffic control have been spelled out by IATA's own Technical Committee. It will suffice, I think, to repeat someone else's phrase that the new generation of aircraft must, to be operated efficiently, be flown like bullets. That is the target—systems of control, communications and meteorology that will enable us to fly an increasing amount of traffic to far closer tolerances than ever before.

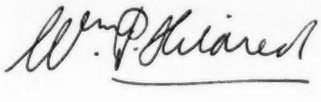
When it comes to the aircraft which will follow our first jets I hope that we can put greater stress on economy and efficiency of operation than on speed for speed's sake. I am not against travelling faster, but I believe we have reached a level of speed that the public will take a generation at least to assimilate in all of its implications. Meanwhile, we have also reached a level of capital requirements and running expense for aircraft, aids and everything else which absolutely dictates the most strenuous efforts to reduce the unit cost of air transport.

All of this is necessary, not merely to enable the airlines to make profits (which is in itself a legitimate objective), but first and foremost to improve their service and lower their charges to the public. In the last six or seven years we have pushed our way at last to the threshold of the mass market. In the next decade or two we must penetrate it more deeply and consolidate ourselves as the carriers of billions, rather than millions of people, and millions rather than thousands of tons of cargo. This is not growth for the sake of aggrandizement: it is a simple statement of the mission of air transport, which is as ever to bind the peoples closer together, to enlarge the horizons of the individual, to stimulate trade and commerce, to quicken the exchange of information and ideas—and in short, to contribute to a happier and more peaceful world.

From airfield to airport... 1933: Air France's modest "terminal building" at Le Bourget. 1958: Still a provisional structure but incomparably more commodious—the terminal building at Paris Orly.

I know that these concerns will continue to be shared by governments; but it is also necessary to hope that they will arrive at a better coordination of their interests in air transport. They have all blessed and many actively enforce the objectives which we seek to serve. But, all too often, the airlines are pushed, hauled and torn in several directions at once by the various departments of the same government. We shall in the future be touching too closely upon the vital interests of all communities, and playing for such huge stakes in national economies, for this to be a safe policy in the public interest.

In looking ahead in this business, one must also look up; and at this point in our development we seem to be spending a great deal of time peering into outer space. It is entirely proper that we should do so—and I trust that we will pay sufficient attention to its challenge to avoid inflicting upon space and posterity the outworn and incongruous concept of nationalism. But I trust also that we shall not needlessly dissipate on adventures beyond our planet resources which can be much better used to improve those agencies which serve the direct benefit and happiness of man.



Competition and Cooperation

Overseas transport 1933—1939

Probably in no other industrial field have long-term projects—however uneconomic or even unrealistic they may have appeared at the beginning—played so decisive and stimulating a role as in air transportation. The best illustration of this is provided by the early thirties. Aviations experts were firmly convinced that the two great oceans, Atlantic and Pacific, would shortly be tamed and opened up to scheduled air services... In reality a good many years were to pass before these results were achieved. It was not until the end of World War II that there was any question of giant ocean airliners as understood today. But as far back as 1928—barely a year after Lindbergh's first flight—Juan Terry Trippe, the young (29) President of Pan American Airways, sat down with representatives of the major European airlines, France's Compagnie Générale Aéropostale and Britain's Imperial Airways, to divide up the world. Spheres of interest were parceled out, Atlantic routes negotiated, possible pool agreements discussed... As if the long-range aircraft were standing ready to go at the end of the runway, with propellers droning or jets roaring.

Looking back it is of course easy to qualify the confidence of these men—to put it mildly—as amazing. Atlantic flying was still deep in the heroic age. To take only one or two examples from the wealth of material on conditions in those far-off days, it will be recalled how little resemblance the first "mail flight", carried out in May 1930 by an Aéropostale Latécoère seaplane, bore to a commercial operation, and how glad the crew—Mermoz, Dabry and Gimié—must have been to have escaped without broken bones. Even four years later, at the end of 1934, when KLM sent the three-engine Fokker F-XVIII "Snip" from Schiphol to Curaçao, West Indies, no fundamental changes had occurred in the situation. The Fokker's cabin was loaded not with passengers but with fuel tanks. A Dutch submarine posted in the South Atlantic provided "air traffic control", and when the pilots landed, with a sigh of relief, they received the highest Dutch decorations... Finally, while on this subject, we must not forget Germany's Dornier DoX flying boat, the 56-ton monster which first alighted in Rio de Janeiro bay in 1931. As there were no high-power engines yet in existence, the DoX had no fewer than 12 power units.

Such in broad outline was the background of facts, from which the enthusiasm of the early thirties stands out with amazing clarity. Incidentally *Interavia* was among the irrepressibles. In an article entitled "The Air Services of the Future" which "Interavia, International Correspondence on Aviation" published at the end of April 1933, the writer stated "...we are very near indeed to a regular air connection between the American and Asian continents; this link will find its complement in the lines radiating from the United States towards South America, the Philippines and Australasia, and has its most important counterpart in the trans-Atlantic route which will reach the European continent through Greenland and Iceland. This America-Europe connection is moreover the pivot of the big international politics of aviation..."

Whether or not their efforts were premature, the three airlines who planned Atlantic flights at such an early date, and our leader-writer, were eventually proved to be right. In the history of air transportation the fourth decade of our century remains inseparably linked with the conquest of the oceans.

The first serious step on the road towards intercontinental air services was taken by the group flights to South and North America organized by Italy's Air Minister, General Italo Balbo: in 1931 he took twelve Savoia-Marchetti S-55 seaplanes (two 500-h.p. Fiat A-22 engines and a crew of four) from Rome to Rio de Janeiro and back to Rome, and in 1933 twenty-four S-55Xs from Rome to Chicago and back.

Of far greater importance from the commercial point of view, however, was the order which Pan American Airways placed in the summer of 1932 for three Sikorsky S-42 flying boats, to a total value of $ 1,000,000. Later these were joined by Martin M-130s and Boeing 314 *Super Clippers*. This prepared the way for the success of PAA's *Yankee Clippers*, which were to win the first round against the Europeans seven years later.

The real contest for the opening of the Atlantic had begun. French, Germans, British and Dutch entered into rivalry with the Americans. What had they to put into the field? First and foremost, well-developed airlines with practical experience of operations to Africa, the Middle East and India, behind which stood the enterprise of the world's trading nations.

Although *Air France* was the youngest of these airlines—ignoring for the moment its predecessors—it represented a powerful concentration of the united French air transport industry. Formed on August 30th, 1933, from the merger of four private companies (Air Union, Air Orient, CIDNA, Farman), it had also taken over the assets and debts of the financially ailing Compagnie Générale Aéropostale and, with them, its South Atlantic heritage.

Imperial Airways Ltd., the "chosen instrument" for Britain's overseas transport which had been founded in 1924, was organizing the Empire Air-mail Scheme. Ten years after the company's foundation its flying boats were landing in South Africa, India and Australia. The degree of confidence which was placed in their efficiency and reliability can be seen from a brief *Interavia* report in Autumn 1933 that the British insurance companies had decided to reduce premiums for air freight to the same level as those for surface transport.

The oldest of the European overseas airlines was *KLM*, which had been founded in 1919 by a group of Dutch bankers and industrialists and whose President, Albert Plesman, pursued an exceptionally far-sighted equipment policy (as will be seen later, KLM was the first European airline to place the Douglas DC-2 in service). Admittedly KLM in those days was less interested in the Atlantic than in the Indian Ocean. At the end of 1933, the Fokker XVIII "Pelikaan" succeeded in cutting travel time between Amsterdam and Batavia (today Jakarta) to four days, four hours and forty minutes. Although traffic volume was still very modest—446 passengers

The beginnings of overseas air transport: KLM opens its Amsterdam – Batavia route with three-engined Fokker F.12s.

Pan American Airways led the way to transocean services with the introduction of multi-engined *Clipper* flying boats (Sikorsky, Boeing, Martin). Picture on the left shows a Sikorsky S-40. — Right: the ceremonial delivery of the first Sikorsky S-42 to PAA. Left to right: Edwin G. Musick (then PAA's Chief Pilot), André Priester (Vice President and Chief Engineer, PAA), Charles Lindbergh (Technical Adviser, PAA), Juan T. Trippe (PAA President), Igor Sikorsky (founder of Sikorsky Aviation Corp.), E. L. Vidal (Director of the U.S. Air Commerce Department), and F. R. Nielson (Sikorsky President).

were carried to the Netherlands East Indies in 1932, 789 in 1933 and 6,156 in 1939—the picture of overseas air services in 1933 would not be complete without KLM.

The German flag carrier, *Deutsche Lufthansa*, founded in 1926, had within a few years developed into one of the most competitive of the European airlines. Its passenger volume rose rapidly, from 70,000 in 1932 to 230,000 in 1936. The German air transport industry had also sent out feelers to South America and Asia shortly after World War I. In Brazil there was the German Condor-Syndikat, in Colombia the German SCADTA, in Ecuador SEDTA, in Bolivia Lloyd Aero Boliviano, and a good proportion of the Chinese domestic traffic was carried by Lufthansa's subsidiary Eurasia. When in 1934 Freiherr von Gablenz, Lufthansa Board member, flew to China by Junkers Ju 52 on a tour of inspection, Eurasia was able to show him the following highly promising traffic results for 1933: 1,031 passengers, 35,198 kg freight, 4,236 kg mail.

There was therefore no lack of well-run solidly-based airlines in Europe. Besides the four companies already mentioned there were, for example, the flag carriers of the three Scandinavian countries—DDL (Denmark), DNL (Norway), SLA, later ABA (Sweden)—which had participated in founding the old International Air Traffic Association back in 1919, and were to unite to form *SAS* after World War II; *Sabena*, organized by the Belgian Government in 1932, was operating promising services in and to the Belgian Congo; Italian air transport was in the hands of Ala Littoria, which developed after the war into Alitalia; in Spain LAPE was at work, to be followed in 1940 by *Iberia* (which succeeded in recording substantial profits during the postwar air transport crisis); Switzerland's *Swissair*, which had grown up out of two smaller companies in 1931, very soon acquired an outstanding reputation thanks to the energy of its Directors, Walter Mittelholzer and Balz Zimmermann. It was the first European airline, in 1932, to operate high-speed Lockheed *Orion* aircraft with the new retractable undercarriage.

The only European contenders in the "battle of the Atlantic", however, were the French, the British, the Germans and the Dutch. The Europeans' main handicap was a shortage of suitable aircraft, which led to many strange expedients. The French were in a relatively good position with their Latécoère flying boats. The Germans had airships and also attempted to solve the problem by catapulting mail aircraft from floating bases (the steamers *Westfalen, Schwabenland* and *Ostmark*). The company in the most embarassing situation was Imperial Airways, whose Short flying boats were excellently suited for the numerous stages on the routes to Africa and India but were of no use across the Atlantic. The rest of Imperial Airways' fleet was described even in British circles as entirely obsolescent. C. G. Grey, the late father of aviation journalism, dismissed it in the following typically expressive terms: "The picture of an Imperial Airways plane was enough to make our gracious Queen Victoria turn in her grave". In brief, Imperial Airways found itself forced into the most astonishing experiments in an attempt to increase range. It envisaged in-flight refuelling and made the so-called "Mayo" combination, consisting of a smaller seaplane carried on the back of a flying boat and released en route to continue the rest of the flight alone.

NORTH ATLANTIC TRAFFIC
AIR/SEA

1946—1957

Passengers (thousands)

	Air	Sea	Total	Air as % of total
1946	105	300	405	26
1947	209	415	624	33
1948	253	501	754	34
1949	273	652	925	30
1950	317	691	1,008	31
1951	342	710	1,052	33
1952	448	844	1,292	35
1953	523	892	1,415	37
1954	581	938	1,519	38
1955	692	962	1,654	42
1956	835	1,008	1,843	45
1957	1,018	1,027	2,045	50

Comparision of passengers carried by the Trans-Atlantic Passenger Steamship Companies and the IATA North Atlantic Air Carriers.

"Pressure cabin", 1939 style.

It was therefore not surprising that the Europeans lost the draw and that the conquest of the oceans, beginning with the Pacific, fell to Pan American.

Between November 22nd and 29th, 1935, a PAA Sikorsky S-42 flying boat opened the San Francisco–Pearl Harbor–Midway–Wake–Guam–Manila service, which was later continued to Canton, China. The installation of its island bases had cost PAA $ 2,000,000. The event was universally acclaimed... except by the Japanese press which prophetically declared that American airports on Guam, Wake and Midway could also be used as military bases if "weather conditions" changed, a remark which was not altogether beside the point, as it later turned out.

Over the North Atlantic the curtain did not rise until four years later. On May 20th, 1939, the New York–Southampton service was opened; on June 17th, the New York–Lisbon service.

An impressive but costly success. The harvest was not reaped until after the war, when it was shared by both Americans and Europeans. Atlantic services have developed into the most rewarding in the world, and by 1956 Europe had secured roughly half the total Atlantic passenger volume.

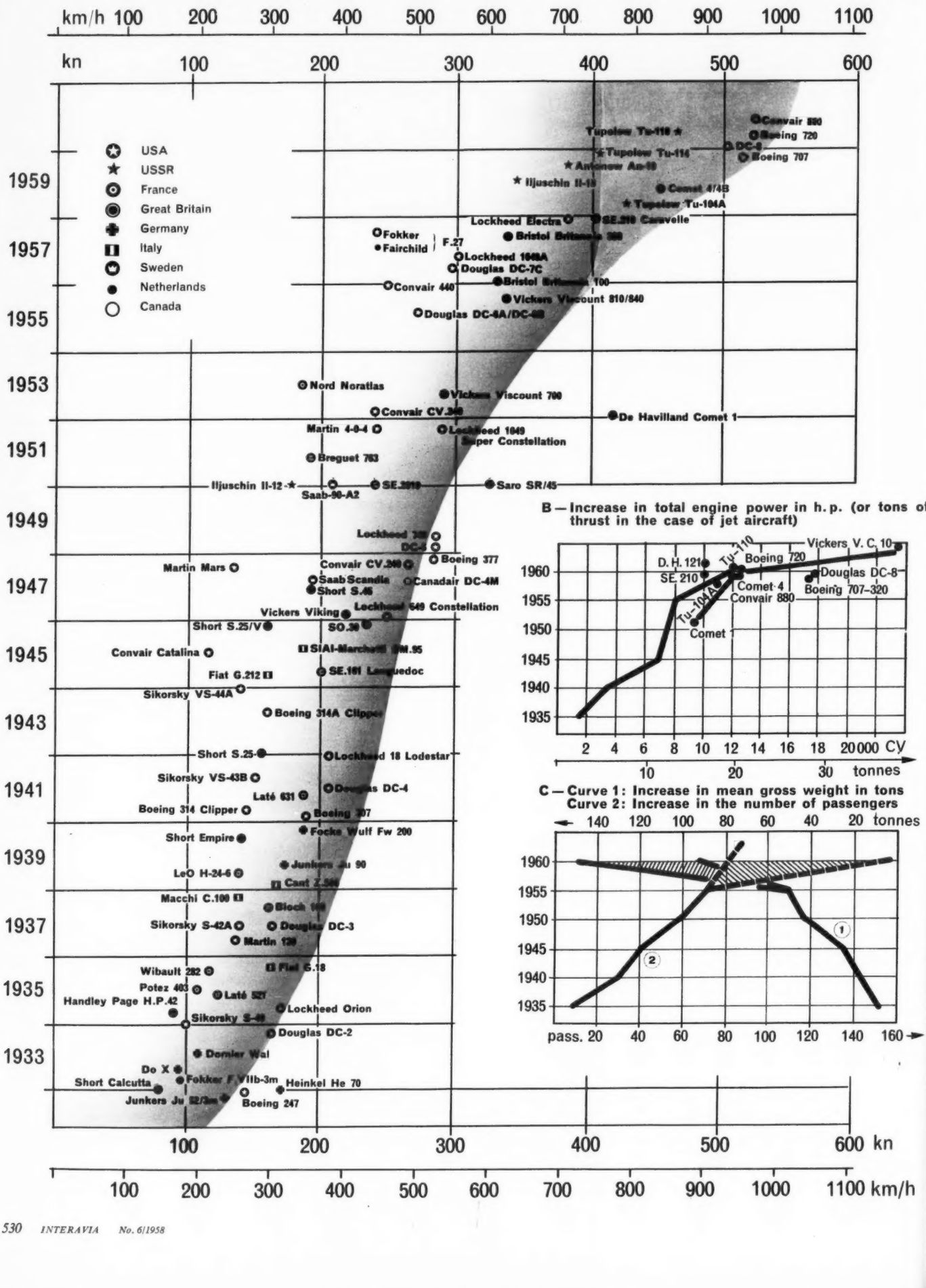
"War and Rumours of War"

The skies began to cloud over for civil aviation several years before World War II. During the 15th Paris Show in 1936 *Interavia* complained bitterly that the stands showed one military aircraft after another, but practically no commercial aircraft. And twelve months later *Interavia* wrote (No. 411–412) that in 1937 fifty-six countries were scheduled to invest roughly $ 1,750,000,000 in aviation, four-fifths of which were destined for military purposes.

Admittedly, good work was still being done for air transport even during this last breathing space before the storm broke, as the following examples will show.

The United States supplied the world's airlines with the Douglas DC-3 short and medium-stage aircraft, which was to be built in the largest numbers ever known (though primarily for use as a military transport) and is still faithfully serving the air transport industry twenty years later. Incidentally, the earlier DC-2 had been entered by KLM in the McRobertson race from Britain to Australia, from which it emerged victorious in the transport class... Here tribute should be paid in the name of the airlines to chocolate manufac-

A — Growth in the mean cruising speed of commercial transports during the past 25 years



B — Increase in total engine power in h.p. (or tons of thrust in the case of jet aircraft)

C — Curve 1: Increase in mean gross weight in tons
Curve 2: Increase in the number of passengers

DEVELOPMENT OF CIVIL AIR TRANSPORT

Scheduled Services - International and Domestic

Revenue Traffic 1932—1957

Year	millions						Average number of passengers per aircraft
	Kilometres Flown	Passengers Carried	Passenger-Kilometres	Passenger Tonne-Kilometres	Cargo Tonne-Kilometres	Mail Tonne-Kilometres	
1932	140	—	405	35	—	—	3
1933	155	—	545	50	—	—	4
1934	160	—	650	60	—	—	4
1935	200	—	975	90	—	—	5
1936	230	—	1,280	115	—	—	6
1937	265	—	1,410	125	—	—	5
1938	300	—	1,685	150	—	—	6
1939	295	—	2,030	185	—	—	7
1940	300	—	2,530	230	—	—	9
1941	340	—	3,280	295	—	—	10
1942	315	—	3,515	315	—	—	11
1943	320	—	4,165	375	—	—	13
1944	415	—	5,490	495	—	—	13
1945	600	9	8,000	720	110	130	13
1946	940	18	16,000	1,440	120	100	17
1947	1,140	21	19,000	1,710	270	130	17
1948	1,270	24	21,000	1,890	420	170	17
1949	1,350	27	24,000	2,160	570	190	18
1950	1,440	31	28,000	2,520	770	200	19
1951	1,620	42	35,000	3,100	930	240	22
1952	1,770	46	40,000	3,570	1,000	260	23
1953	1,920	52	47,000	4,140	1,050	280	24
1954	2,070	58	53,000	4,670	1,130	330	26
1955	2,300	68	62,000	5,440	1,330	380	27
1956	2,540	77	71,000	6,260	1,510	410	28
1957	2,830	87	82,000	7,210	1,680	440	29

Source: ICAO. Excluding People's Republic of China, USSR

turer MacPherson Robertson. Though his main object in financing the Australia race may have been to increase chocolate sales rather than transport volume, the ultimate outcome was undoubtedly of benefit to the airlines.

*

Another event was of the utmost importance to the subsequent development of air transportation; shortly before the war the U.S. airlines set up the organization which was to enable them, in the postwar years, to meet foreign competition as a body. Early in 1936 twelve U.S. carriers founded the Air Transport Association. Two years later the 1938 Civil Aeronautics Act was passed, and the Civil Aeronautics Authority was set up. The latter was later to divide into the present Civil Aeronautics Administration and the Civil Aeronautics Board. From then on American air transportation became subject to "regulated competition", which prevented monopolistic developments on the national level. The award of routes to U.S. airlines and route negotiations with foreign companies were in the hands of a single authority... (at any rate theoretically; in practice rivalry between the CAB and the State Department in the latter field has never entirely ceased).

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And in Europe? A few weeks before the outbreak of war the British air transport industry underwent a transformation. Early in August 1939 the House of Commons approved the statutes of British Overseas Airways Corporation, which took over from Imperial Airways and British Airways Ltd. By awarding increased Government assistance and ensuring the new Corporation a virtual monopoly on overseas routes, it was hoped that fleet problems could finally be settled. But despite the founding of BOAC, the aircraft question remained a stumbling block in British air transport for many years. However that may be, from the organizational point of view the first step had been taken on the road which was to lead after the war to the creation of British European Airways (August 1st, 1946).

For the time being, however, there were more urgent tasks to be tackled, and the newly-formed BOAC had to don battle-dress. Transformed into a military transport service, it was almost entirely annihilated during the war and lost practically all the long-range aircraft which might later have been used for civil trans-Atlantic services.

Growth of mean cruising speed of commercial transports during the past twenty-five years

Diagram A illustrates the increase in mean cruising speed of a selected number of typical commercial aircraft. Note the sudden rise on the introduction of the first modern types, still in service today, such as the DC-4, DC-6, *Constellation*, etc. At the lower end of the scale are the seaplanes and flying boats which were still in operation in large numbers up to the outbreak of war. The process was repeated with the advent of the first turboprop aircraft in 1953, and the cruising speeds of the aircraft now used in air transportation lie, with few exceptions, in the 250—400 knot range. When jet transports come into use speeds will rise to more than 500 knots, but will probably not change greatly for several years after that.

Diagram B shows the mean increase in total engine take-off power in commercial transports (e. g., all four engines taken together in the four-engined aircraft, etc.). The curve is based on piston engine and turboprop types, and the jet aircraft now on order are shown separately. The power given for jet types is the maximum static thrust at sea level.

Diagram C indicates on the one hand the rise in mean gross weight in metric tonnes (curve 1; one metric tonne = 2,200 lb.), and on the other the increase in mean passenger seating capacity (curve 2). Both curves rise sharply in 1955, with the introduction of large aircraft in the true sense of the word (80 to more than 100 passengers), and again at the end of 1958 when the first jet types are due to come into service. In view of the fact that a large number of small and medium size aircraft will remain in service alongside the jet giants, curves 1 and 2 are split from 1955 onwards to indicate maximum and minimum values.

Typical aircraft of the thirties: Using the Junkers Ju 52, Lufthansa succeeded in quadrupling its passenger volume between 1932 and 1936...

...In the mid-thirties Ala Littoria was operating four-engined Savoia-Marchetti SM-74s for 20 to 27 passengers...

...The first American high-speed aircraft with retractable undercarriage caused something of a sensation; Swissair placed the Lockheed *Orion* in service in 1932...

...TWA's fleet in the mid-thirties already consisted mainly of Douglas DC-2s and, later, DC-3s, which inaugurated modern air transportation...

...Range problems forced Imperial Airways into the strangest experiments. Picture shows the Short *Mayo* pick-a-back combination.

BOAC was not the only victim of the war. The French, German, Italian and Dutch airlines also succumbed, and though Belgian's Sabena was able to transfer the whole of its fleet, but for one aircraft, to the Belgian Congo or Allied countries, it suffered so severely in military service that nothing worth mentioning survived. For six years the European airspace was the home of bombers, fighters and military transports. Europe travelled by train again.

In a more favourable position were the U.S. airlines, whose fleets—roughly 350 aircraft in 1941—to a large extent remained in the hands of the mobilized companies and were operated by them for both military and civil transport tasks.

1933: The Boeing 247, with two 550 h.p. Pratt & Whitney *Wasp* engines, already had a "modern" cockpit, whose instrument panel included a Sperry autopilot.

The organization of world air transport

Both in the Old and the New World air transport questions were removed from the agenda, or at least put very much in second place, during the early war years. More urgent problems faced the nations. Later however, as the storm began to subside, it was to be found that in several respects the war period had done much to further air transport. Long-range experience, long-range aircraft and pilots of unequalled skill formed part of its legacy. But this was later. Meanwhile the air transport men were wearing uniform, air transport authorities, statesmen and parliaments were concerned first and foremost with supplying the fighting units with combat aircraft, and the press had to devote itself to more urgent topics of direct concern to all.

By the time two or three years had passed, however, there was a growing number of people who began to ask about the future. In all countries, and particularly in the United States and Britain, reports began to trickle through about international feelers between air transport experts. Vice-President Henry A. Wallace, addressing the Congress, pleaded for the internationalization of air transport, and in England Edward P. Warner, Vice Chairman of the U.S. Civil Aeronautics Board, read a guest paper to the Royal Aeronautical Society on "Postwar Transport Aircraft".

Being published in neutral Switzerland, *Interavia* felt under a particular obligation to open its columns to these subjects. "...And after the war?", it asked in September 1941 (No. 782). "Those who can't see the light now will never be able to see it. When peace has returned, large portions of the war transport fleets will be turned over to commercial air service duties. Flying personnel of the air forces will supplement the existing strength of airline personnel... A commercial air organization will arise which in importance and value will never take second place to any other means of transportation".

And in 1943, at the time of the first preliminary talks on an international air transport conference, *Interavia* wrote "...the designers will not fail. Statesmen, and the peoples whose interests the statesmen serve, *must* not".

Have they failed? Opinions on the Chicago civil aviation conference of December 1944 and on the International Civil Aviation Organization which it created are divided.

In the view of those who had hoped for an international "control authority" with full powers after the war, ICAO provides only a partial solution. "An amicable agreement to disagree" are the words with which BBC commentator E. C. Shepherd described the results of Chicago at the time.

In the light of subsequent experience, we consider Shepherd's remark to have been a little too hasty. Edward P. Warner, the first President of the ICAO Council (who handed over his office to Walter Binaghi early last year), succeeded in gaining uncontested authority for his organization. In the technical field ICAO has achieved more with its Standards and Recommended Practices than the airlines had dared to hope. Without its cooperation, the organization of the forthcoming jet services would be barely conceivable. In the economic field, however, ICAO has not been able to make much progress. The powers that would have been necessary for this were withheld from its statutes. Instead of the Five Freedoms*, on which no agreement was reached in Chicago, instead of a multilateral agreement for the liberalization of world air transport, there grew up the present labyrinth of countless bilateral agreements "regulating" air transport relations. The first of these bilateral agreements, which was to serve as model for all subsequent drafts, was signed between the Americans and British in Bermuda in 1946.

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Following the example of their governments, the airlines also founded their own international organization. The airline delegates attending the Chicago negotiations got together for separate talks and decided to expand the pre-war IATA, which had been a purely European association, into a world-wide organization. The first general meeting of the new International Air Transport Association, held in Montreal in October 1945, appointed Sir William P. Hildred, then Director-General of Civil Aviation in Britain, as IATA's Director-General.

IATA's main tasks were to create a uniform rates structure for international services, to reconcile the conflicting interests of its member companies and to represent the rights of air transport vis-à-vis governments and other international organizations.

But IATA could not work miracles, for as experience well shows, when cash is involved, altruism pales. Nevertheless, its successes during the past twelve years must not be underestimated. Two examples will suffice: the decision of the Nice Traffic Conference in December 1952 to introduce the tourist class cut the cost of air travel on a world-wide scale by roughly 30 percent and won over new classes of customers to air travel. The Clearing House set up by IATA in London is designed first and foremost to serve the carriers, but in enabling companies to settle their accounts without the transfer of cash it has reduced operating costs, which ultimately also benefits the travelling public.

Space travel in sight

The old romantic days of the flying boat had definitely passed by the end of the war. The real initiates had foreseen the end at the time when the flying boat was celebrating its greatest triumphs. Jean Mermoz, whose life's work was bound up with this category of aircraft, had given his vote to the landplane as early as 1935: "A suitably designed multi-engined aircraft will not be obliged to come down on the water because of mechanical troubles..." The flying boat offered no special advantages. "A Pan American Airways Sikorsky flying boat carrying 26 passengers, including the Brazilian Air Minister, tried four times in vain to alight in the Bay of Rio de Janeiro in almost windless weather and with waves of only four to six inches". And KLM President

Scandinavian Airlines System opened the first Arctic service between Copenhagen and Los Angeles with Douglas DC-6Bs on November 15th, 1954.

* The first two freedoms – the right to operate non-stop through the air-space of a second nation and to stop for non-traffic purposes – are transit privileges which have been accepted by most of the member countries. The other three are commercial privileges and they have remained largely on paper. They are the right to discharge cargo in the territory of the second nation, the right to pick up cargo in the second country destined for the first, and the right to pick up or discharge in the second nation cargo destined to or coming from the territory of a third nation.

TYPICAL TURBINE AIRCRAFT

Vickers *Viscount* turboprop transport (first flight July 1948).

The Bristol *Britannia* which has formed part of BOAC's fleet since February 1957.

Fokker is scheduled to deliver the first F.27 *Friendship* to Aer Lingus in the autumn of 1958 (Fairchild is also building this aircraft under licence).

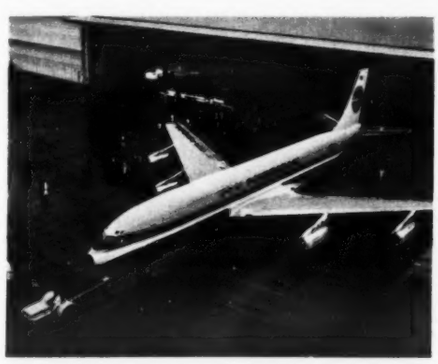
The turboprop Lockheed *Electra* is also due to enter service next September.

Air France will take over its first SE.210 *Caravelle* jet transport at the end of 1958.

The de Havilland *Comet* 4 for BOAC made its first flight on April 27th, 1958.

Plesman prophesied in 1936 that the Atlantic flying boats with their vast dead weight would be displaced in four or five years by giant four-engined landplanes which would be able to fly from London to New York in about 16 hours. This aircraft category was provided by the Americans in the postwar years. The Douglas DC-4, first presented in 1939, developed into the DC-6 and the latter into the DC-6B. Lockheed contributed the *Constellation, Super Constellation* and *Starliner*. Boeing presented the *Stratocruiser*. This promised invasion of heavy aircraft led *Interavia* to the conclusion (expressed in No. 1, 1947) that, however ungratifying it might be to the Europeans, America was now leading the world. If further proof had been needed it was provided by the fact that CAB awarded three U.S. airlines the first round-the-world routes in June 1946: PAA was given one route across both the Atlantic and the Pacific, while TWA and Northwest Airlines were to share another.

The European airlines did not catch up again until they decided to purchase American aircraft. But then competition became really keen, and today Atlantic traffic is shared fifty-fifty. Since the end of 1954 the two continents have also been connected by Arctic services; the honour of inaugurating the first Polar route goes to a European airline, Scandinavian Airlines System, which opened the Copenhagen–Iceland–Greenland–Canada–Los Angeles service with a DC-6B on November 15th, 1954. The route has now been extended to Tokyo. Other Arctic services have since been inaugurated by Canadian Pacific Airlines (June 1955), Pan American World Airways and Trans World Airlines (September 1957) and Air France (April 1958).



Jet giants for intercontinental services: Above, Boeing 707; below Douglas DC-8.

Meanwhile turbine services have become a reality, and many airlines in both the New and the Old World are already operating turboprop aircraft. British Overseas Airways Corporation's experiment with jet services between 1952 and 1954—followed by Russia's Aeroflot early in 1956—will be emulated within the year on air routes throughout the world. The West's airlines have placed orders for jet aircraft to a total value of some $ 3,000,000,000. But the aircraft industry is by no means resting on its laurels. Projects for supersonic and VTOL transports are already on file in American and European design offices. When these new projects come to fruition, the hard-pressed carriers will again have to face the problem of finding funds for yet another radical re-equipment programme.

And a new long-term target is emerging above the horizon, though it is probably much more distant than were Atlantic services in the early thirties. When will space travel become a normal means of communication? Only the stars—and a few industrious writers who appear to have a direct line to them—can tell. What is certain, however, is that the air transport industry will not recoil from any reasonable project... even if it takes them into outer space.

A Quarter Century of Military Aviation

From Douhet to the Deterrent Concept

By General L. M. Chassin, Paris

The story of twenty-five years military aviation demands an introduction by a Staff Officer who has himself served through the period. Général d'Armée Aérienne L. M. Chassin has 32 years service in the French Air Force to his credit; in 1939 he commanded a medium-bomber wing and from 1951 to 1953 was Commander-in-Chief of the French Air Force in Indo-China. Up to the time of his retirement in the spring of 1958, General Chassin was attached to SHAPE where he was Air Defence Coordinator, Central Europe. His reputation as a writer on military aviation is well known to *Interavia* readers. **Editors**

It was Jules Michelet, the nineteenth century's far-sighted French historian, who first became aware of the strange phenomen of the rising tempo of life. Indeed, in all fields, developments are tending to occur more and more rapidly in our small world; and this speeding-up process applies equally to population figures, social evolution, the rhythm of production and scientific discovery, or the performance of machines.

The history of military aviation is a striking example of this mysterious process. Originally scorned and later the handmaiden of the other services, the air arm has within a bare quarter century embarked on its struggle for independence, won equality, and taken pride of place to the point of becoming the decisive factor in battle; today, after many brilliant exploits and at a moment when its supremacy is universally recognized, it is confronted with the most formidable conversion and re-equipment problems of its history—all because of the constantly accelerating tempo of events.

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After watching the first display of military aircraft in 1910, General Foch, the West's No. 1 theorist, declared roundly: "This is just a form of sport—aircraft are of no use to us." Four years later, during World War I, the new weapon resoundingly proved Foch wrong. In the technical field it made giant strides: speeds rose from 75 to 150 m. p. h., and altitudes from 3,000 to 22,000 ft. And as will always be the case, technical progress led to progress in tactics and strategy. Reconnaissance, artillery observation, battlefield support made the air arm into a valuable and henceforth indispensable adjunct to the army. Soon the first bombers made their timid appearance, and Billy Mitchell advanced the revolutionary idea of an "independent air force," capable of acting on its own, away from the sordid battles fought by impotent pygmies on the ground.

The ensuing controversy lasted for nearly twenty years. The one great name which stands out among the throng of writers on military theory is that of Giulio Douhet. His theory—that of the air force as the dominant arm—is simple, clear and powerful. It can be summarized in a single sentence: "Hold the line on the ground and strike from the air en masse." It may be noted in passing that this is still our guiding principle today! But ultimately every theory requires equipment to enable it to be put into practice. Despite the progress that had been made in both airframes and engines by 1933, despite the distance record of 9,105 km set up by Codos and Rossi (in a Blériot 110), Lemoine's altitude record of 13,600 m (Potez 50), and Agello's speed record of 682 km/h (Macchi-Castoldi MC. 72), the "battleships of the air" envisaged by the Italian general and which several countries had built under the name of "multi-seat combat aircraft" had neither the performance nor the striking power to enable them to deal the enemy any decisive blows, even had they been able to get through the defences. Their speed, less than 200 m. p. h. at 13,000 ft., was laughable, and their bomb capacity much too low. None of the "heavies" of less than 10 tons, such as the Amiot 142 or the Bloch 200, came anywhere near the proclaimed ideal of carrying a ton of conventional bombs over a range of 600 miles.

Yet 1933 was a definite turning point for the air forces. The Geneva disarmament conference, on which so many hopes had been placed, had bogged down, and this was the year of Hitler's accession to power. From now on all countries were to turn one after the other to rearming in the air. German strategists, under the influence of a traditionally all-powerful army, resolutely opposed the Douhet theory and built an air arm designed essentially to support surface operations. Here the

famous *Stuka* dive bomber was to ally with the tank to form an irresistible pair. In the United States, on the other hand, the young colonels in the Army Air Corps remained faithful to Douhet and commissioned the *Flying Fortress*. Britain concentrated on defence of the British Isles. France—although she had just created an independent Air Force—abandoned Douhet and attempted to do everything at once, fighters, bombers and army cooperation aircraft. Russia, a mystery even then, seemed to be following German ideas. Then came the war of 1939!

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It was to bring radical changes in military thinking. Operations proved that air superiority was now the *sine qua non* for victory on land or at sea. On land, the Germans, like the Japanese, had to retreat as soon as they lost the mastery of the air. At sea, aircraft carriers revolutionized tactics and reduced the proud battleships to the role of flunkeys in battles between fleets hundreds of miles apart, in which not a single cannon shot was fired. At the same time independent air operations were found to be, if not decisive, at any rate of capital importance. Despite the progress made by fighters and the introduction of radar, armadas of bombers of increasing weight and increasing numbers saturated the defenses and carried death and destruction to the far corners of the enemies' territories. Since all the belligerents fortunately eschewed the use of poison gas, the weapons at their disposal were not sufficiently powerful to prove Douhet entirely right. But performance increased at a bewildering rate, and air fleets grew to hitherto inconceivable proportions. By 1946 the U. S. Army Air Forces numbered 42,243 aircraft and 2,340,000 men, while the Army itself had no more than 3,200,000 men and around a hundred divisions. Britain devoted 50 percent of its war effort to the air arm, and Germany 40 percent. In all countries opposition vanished in the face of the results achieved, and the air forces won equality with their older partners in the highest military councils.

Yet it was not until the final phases of the war that the real innovations appeared, innovations which were once again to change the face of war. The advent of jet fighters was followed by the V2 rocket missile and the Hiroshima atomic bomb, two apocalyptic monsters which have cast their awful shadow over a terrified humanity.

The power of this bomb is so frightening that a single blow can now cause as much destruction as thousands of conventional bombers operating over many months. The offensive has taken a giant step forward and incontestably outclassed the defences, which can no longer afford to let through even *a single* attacker. The equally frightening speed of the rocket still further adds to these difficulties. The decisive weapon of the future, the missile with thermonuclear warhead capable of reaching any point on the globe, is in preparation. A new page has been turned in the world's military history.

The post-war period has confirmed this revolution and the triumph of Douhet's theories. The Atlantic Alliance, formed in 1949 on the ruins of the old anti-Hitler coalition, elaborated a theory based on the principle of immediate retaliation with the heaviest possible weight of airborne atomic weapons. On the ground the sole task of the land forces, now on the defensive, was to prevent our territory from being overrun before the jet bombers could achieve victory. For several years the atomic monopoly maintained peace. But soon the USSR also acquired the same weapons and built a powerful strategic air force. There followed a balance of power based on fear. For the first time in its history, mankind realizes that it holds within its hands the means of committing universal suicide. But the end is not yet!

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We come now to the "last" chapter in this brief history, the chapter in which the unmanned missile, offspring of Ziolkovski, Oberth, Goddard and many others, has at last become operational and is threatening to displace from the centre of the stage the piloted aircraft which is already considered as "finished" after a brief life of 50 years. Admittedly there are domains in which the robot will never be able to replace the human pilot, namely all those tasks where rapid appreciation and decided action must be taken in the face of unexpected circumstances. Communications, transport, observation, tactical support, almost all the work concerned with the immediate battlefield, now grown to hundreds of miles in size, would seem to be closed to the robot. So would the new domain of peripheral wars, where the light aircraft and helicopters of today will be replaced by the convertible aircraft and flying tanks of tomorrow. On the other hand, air defence, interdiction and, soon, long-range attack can well be allocated to missiles.

Whatever happens, the air arm will change profoundly during the years to come, and in all countries. The realization that nuclear wars mean mutual suicide brings conventional war within the bounds of probability, and it would be extremely unwise to stop building manned aircraft. Meanwhile, in creating missile forces, every effort must be made to avoid the organizational difficulties which have plagued the brief life of conventional air forces. Just as the cavalry took over the armoured vehicles, so must the air force take over the new weapons. It has been dealing with problems of air warfare since its birth, and it alone possesses the theorists, the organizers and, perhaps above all, the technicians capable of adapting themselves rapidly to the new problems that are bound to arise.

As two kinds of war are, alas, possible, the air forces of tomorrow will be mixed. They will comprise both robots and piloted aircraft. The latter, wingless and with vertical take-off and landing characteristics, will soon bear very little resemblance to those of 1933. But the essential point is that they should continue to be piloted. If man proved incapable of controlling the infernal machines which he has created, the future would be black for humanity. After a quarter of a century of technological progress, the time has come to search our consciences. Tomorrow may be too late!

Air Power in Theory and Practice

Giulio Douhet's death in 1930 was followed six years later by the passing of another air power visionary, the American "Billy" Mitchell. The doctrines of both Generals on the subject of "air supremacy" and, in the last analysis, the decisive role of strategic bombing in war, were widely argued by the "military experts" but were rarely wholeheartedly accepted and, in practice, had even less immediate effect on the rearmament programmes then being put through by the different major powers. It was inevitably the case that each nation drew its own conclusions and went its own way, depending on its interpretation of the political and geographical factors.

*

Italy, Douhet's own mother country, had in the shape of her very efficient Savoia S.79 bomber (3,000-lb. bomb load over a radius of action of more than 600 miles) the basic tool for the building of a strategic air force, but neither the national financial nor industrial resources would permit the acquisition of an adequately large fleet. Placed under Army command in World War II, the available bombers were frittered away in penny packets. In both quantity and quality the fighter forces continued to play the role of a poor relation. Ironically, in 1933 Douhet's most talented disciple and supporter, the energetic Air Marshal Balbo, had been banished by Mussolini to the wilderness of Libya.

*

In *Germany* General Wever, the Luftwaffe's first Chief of Staff, was a convinced Douhet supporter, but at the same time he was realist enough to appreciate that on the grounds of economy and personnel alone, it would scarcely be possible for Germany to develop the *strategic* air arm of a major power. The Luftwaffe war-games of the time showed that Wever was planning only for a defensive war to be fought in coalition with stronger allies. Nevertheless he advocated the principle of concentrated attack in air warfare, first to crush the opponent's air power, and later to smash his armaments industry and thus pave the way for the advance of the ground forces; on the other hand direct support for the army and air defence of the home territory should be provided only by smaller air forces.

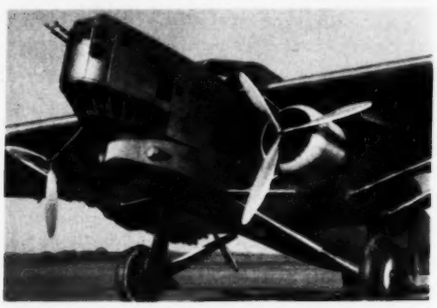
The pre-war Luftwaffe equipment programme was cut closely to this pattern. In the first place twin-engined bombers (He 111, Do 17, Ju 86, and later

Left to right: Marshal Italo Balbo, architect of the Italian Air Force, and Air Minister up to 1933; Generaloberst Hans Jeschonnek, Luftwaffe Chief of Staff 1938–1943; General Joseph Vuillemin, France's Chief of the Air Staff at the outbreak of war in 1939; Marshal of the RAF Lord Tedder, Deputy Supreme Commander SHAFE 1943–1945, Chief of Britain's Air Staff 1946–1950; General Henry H. Arnold, Commanding General of the Army Air Corps and Army Air Force 1938–1946, the "father" of the USAF.

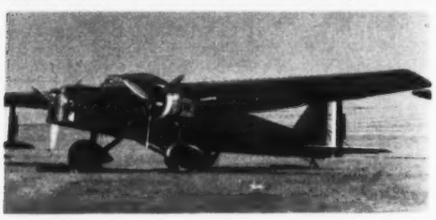
1933: Handley Page *Heyford* night bomber (two 600-h.p. Rolls-Royce *Kestrel IIIs*) with four-man crew.

1933: Boeing F4B-4 single-seat fighter (500-h.p. Pratt & Whitney *Wasp*).

1934: Gloster *Gladiator* single-seat fighter (715-h.p. Bristol *Mercury*).



1934: Farman 221 night bomber (four 700-h.p. Gnome Rhône 14Ks); bomb load 2,200 lb.; range 1,000 miles.



1934: Bloch 200 night bomber (two 700-h.p. Gnome Rhône 14Ks); bomb load 2,600 lb.; range 600 miles.

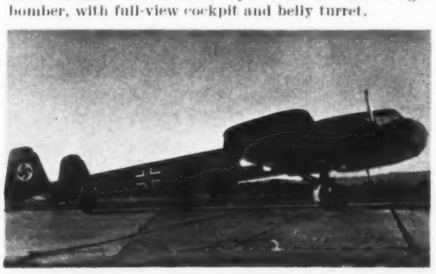
1934: ANT-6, the Soviet Union's first "heavy" bomber range with 3,000 lb. bomb load approx. 1,200 miles.

1935: Savoia S.79 (three 610-h.p. Piaggio *Stella IXs*), Italy's main World War II bomber.

1935/36: Boeing YB-17 (four 700-h.p. Pratt & Whitney *Hornets*, later with four 1,000-h.p. Wright *Cyclone 6s*), forerunner of the universally employed *Flying Fortress*.

1938: Bristol *Blenheim* light bomber (two 920-h.p. Bristol *Mercury VIIIs*).

1939: Dornier Do 215, developed from the Do 17 light bomber, with full-view cockpit and belly turret.



1935/36: J-16 *Rata*, a Soviet fighter with retractable undercarriage, prominent in the Spanish Civil War.

Ju 88) were built, together with escort destroyers (Me 110), in all cases for limited radius of action; second priority was given to long-range reconnaissance aircraft (Do 17), dive-bombers (Ju 87) and transports (Ju 52) for parachute troops; fighters (at first only the Me 109, but later also the Fw 190) came a poor third in Germany's planning. In September 1939 the Luftwaffe went to war with a little over 4,300 first-line aircraft: 30 bomber, 10 attack, 13 day-fighter and 9 *Stuka* groups, each of 27 aircraft plus reserves; added to which were 23 strategic reconnaissance squadrons (of 16 aircraft each), 552 transports, 342 tactical reconnaissance, 240 naval and roughly 100 ancillary aircraft. The bombs utilized were of the 25-lb. (fragmentation) and 100 and 500-lb. (high-explosive) categories, and it was not until later in the war that bomb weights were boosted to the two, three and four-thousand pound class. Thus in 1939, each of Germany's 30 Bomber Groups could deliver a maximum 30/45-ton punch at a given target area, providing that this was within 400—500 miles range. Such an air arm was fully capable of smashing the resistance of the Polish Air Force's 900 first-line aircraft and, with its efficient fighters, at the same time hold in check the French Air Force's obsolete bombers. But for a strategic air war against Great Britain's island fortress or the vast land masses of the Soviet Union it fell far short of the mark. Ignoring the converted Fw 200 *Kondor* civil transports, Germany did not possess one single four-engined long-range bomber.

Wever managed to write himself off in a 1936 air crash, and his successors were men of far less vision. Chief of Staff Jeschonnek and his colleagues deluded themselves on the striking power of both their own and their possible opponents' air forces, and were unable to avoid the blighting effect of the party machine's interference in their affairs. The result was that the Luftwaffe was committed to strategic tasks for which it was neither technically equipped nor staffed, and eventually bled to death in the tactical support role on the Eastern Front. In August 1943, when even the air defence of the fatherland collapsed under the weight of the Anglo-American bombing onslaught, Jeschonnek took his own life.

Once so confident, over-estimated both at home and abroad, the German Air Force was now little more than a shambles. It had never fully recovered from the reverses suffered in the Battle of Britain (autumn 1940), and had been decimated by the blood-bath in Russia. In the transport squadron operations at Stalingrad it had lost the last pilots capable of training the rising generation. The development of the four-engined He 177 bomber (with double engines) proved to be a failure, and its contemporary, the Me 264, was never tackled seriously. Production of the revolutionary Me 262 jet fighter, which would at least have given a new lease of life to the air defences, was delayed in favour of Hitler's obsession with the militarily senseless "Reprisal Weapons"—the V1 pilotless bomber and the V2 rocket weapon.

*

France, emerging from the first World War as the strongest air power in the world, accepted from Douhet's teachings not only the concept of an independent air arm as the third partner in the armed forces (effected in April, 1933), but also his danger-fraught cardinal error—the ill-fated concept of the heavily-armed multi-seat "Battle Cruiser". During the Spanish Civil War France was belatedly forced to recognize the fact that her multi-purpose battle planes were in every way inferior to the specialized aircraft appearing on the other side; the numerous defensive positions reduced the bomb load to negligible proportions, and the heavy, cumbersome aircraft were easy prey to the faster and more manoeuvrable fighters then appearing on the scene. The French Air Force was numerically powerful, with its roughly 4,500 combat aircraft, but operationally it was second rate. In the face of mounting international tension it was too late for a change of plan, even if this had been practicable with the wavering "prototype mentality" then prevailing in the Air Ministry, and the wearisome and over-complicated nationalization of the aircraft industry then in process. Chief of Staff General Vuillemin who, from personal experience during his visits to Germany, knew the quality of his opponent's fighters and "destroyers", did his best to strengthen France's air defences; but the few modern fighters and strike aircraft produced by her own industry (e.g., Morane 405 and Potez 63) only became available in dribs and drabs, and the fighters and tactical bombers on order from the United States without exception arrived too late to be of any use. Thus, in the decisive weeks of May and June 1940, France had many first-class pilots but completely inadequate equipment and, to all intents and purposes, the Armée de l'Air stood and faced the enemy with bare hands.

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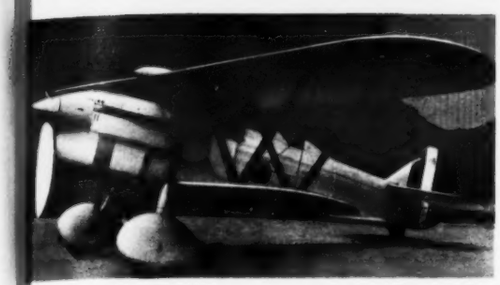
In *Great Britain* there had been no direct acceptance of Douhet's doctrine. The trends in the country's

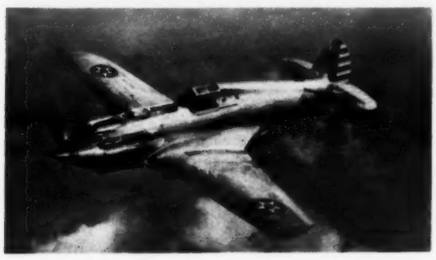


1933/34: Fiat CR.32 single-seat fighter (550-h.p. Fiat A.30R-A).

1936/38: Morane-Saulnier 405 (860-h.p. Hispano-Suiza 12Y), standard fighter of the pre-war French Air Force.

1935/36: B.F.W. (Messerschmitt) BF109 (950-h.p. Daimler Benz 600), prototype for the Me-109 series.

1937: Hawker *Hurricane I* (1,030-h.p. Rolls-Royce Merlin II), first RAF fighter with cantilever wings and retractable undercarriage.



1938: Curtiss XP-40 (1,150-h.p. supercharged Allison V-1710); maximum speed 330 m.p.h.

1937: Fokker G.1 two-seat fighter and reconnaissance aircraft with twin tail booms (two 830-h.p. Bristol *Mercury VIIIs*).

pre-war conception of air strategy were outlined in a series of articles, written by General Golovine with official blessing, appearing in the Royal Air Force Quarterly. From this it could be seen that Britain's strategy was based on the assumption that she would never have to fight alone in Europe, and could therefore take her allies' air power into consideration in planning her own air force; on the other hand it was clearly essential to make provision for the defence of the country in the event of isolation from her allies. The result was a clearcut three-way division of the air arm's charter into an *expeditionary air force* (reconnaissance, bomber and attack aircraft) which would fight side by side with her allies' air forces; *support air forces* for the Army (reconnaissance and day-fighter aircraft) and the Navy (carrier-borne fighters and torpedo-bombers); and thirdly a powerful *defensive air force* with day-fighters for the protection of the British Isles.

Following successful British design experience in the Schneider Trophy Cup (for seaplanes), Hawker and Vickers-Supermarine designed and developed a new generation of fast fighters, armed with 8 synchronized machine-guns. Built around the high-performance Rolls-Royce *Merlin* engines (1,030 h.p. combat rating) the Hawker *Hurricane* (first flight 1935) and the Supermarine *Spitfire* achieved speeds of 325 and 360 m.p.h. respectively, with an operational ceiling of 20,000 feet, and were superior to any other single-seat fighters in the world. In 1936 the *Hurricane* and *Spitfire* were put into large-scale production, and were shortly followed into service in 1938/1939 by the Bristol *Blenheim* and Vickers *Wellington* twin-engined bombers. Also in 1936 the Air Ministry, following the lead given by the United States, undertook a programme for the development of four-engined long-range strategic bombers which led first to the Short *Stirling*, later to be followed by the Avro *Lancaster* and Handley Page *Halifax*.

At the outbreak of war the Royal Air Force mustered 33 bomber squadrons (including a proportion of *Blenheims* and *Wellingtons*), 35 *Hurricane* and *Spitfire* fighter squadrons, and 19 coastal squadrons, a total of some 1,900 first-line combat aircraft. By the critical month of August 1940 strenuous efforts by the aircraft industry and its "shadow factories" had raised the figure to 2,900; Lockheed *Hudson* (A-29) and *Ventura* (B-34), Martin *Maryland* (A-27) and Douglas *Boston* (A-20 *Havoc*) medium bombers were on the way from the United States.

British pre-war concentration on the build-up of a defensive air arm and an early-warning radar network along the coastline paid dividends. Germany's Luftwaffe lost the Battle of Britain and retired to lick its wounds before launching a new attack—this time against Russia. The night bombing offensive against English cities and industrial centres in the winter of 1940/1941 (christened "The Blitz" by irrepressible Londoners) was also abandoned in the face of mounting losses inflicted by improving night-fighters and radar equipment.

From 1942 onwards an increasing flow of four-engined bombers of the *Stirling*, *Lancaster* and *Halifax* class put the RAF in a position to hit back, mainly in night attacks, at German cities and industrial centres with incendiaries and high explosive bombs.

*

Before the war the *United States* divided its air power between the U.S. Navy and the U.S. Army Air Corps, a situation which still exists today although with changed emphasis, the latter having emerged as the independent U.S.A.F. Of the two arms, the U.S. Navy was the more important on the basis of its large aircraft carriers and numerous carrier-borne fighters and dive-bombers.

For obvious reasons Mitchell's (and Douhet's) theories found support only in Army Air Corps circles, where the defence of Alaska and the Aleutians against seaborne attack had already raised a demand for long-range bombers. The bringing into service of the Martin B-10 (2,000-lb. bomb load over ranges up to 2,000 miles) in 1934, and the first flight of the Boeing *YB-17 Flying Fortress* in 1935 were decisive steps towards further technical developments. The Army Air Corps had by this time already slated an additional requirement for an aircraft with 5,000 miles range, cruising speed 200 m.p.h., and 2,000-lb. bomb load to "destroy distant land and naval targets by bombing"; the Boeing XB-15 first flew in 1937 and, although it proved to be too heavy for the powerplants then available, it was to be the forerunner of the B-29 *Superfortress* which played such an important role in World War II. Thus the Army Air Corps was given more and more long-range equipment to extend an originally purely defensive concept into a programme of strategic counterattack, reaching out beyond the Aleutians towards Eastern Asia. There was already talk of "Expeditionary Air Fleets" and General Douglas MacArthur, then United States Army Chief of Staff, stated in a report that the air arm should no longer be restricted to the protection of the ponderous ground forces, but would have to win control of the air ahead of the Army, and thus lead the way.

But there was a wide chasm between planning and reality. Of the 800 Air Corps first-line aircraft available in 1939, some 700 were obsolete by the time of Pearl Harbor. In December 1941 only the Boeing B-17*E* strategic bomber was superior to the contemporary British and German aircraft, but soon to come into service in increasing numbers were the Douglas A-20, North American B-25 and Martin B-26 medium bombers, and, by no means least important, the Lockheed P-38, Bell P-39 and Curtiss P-40 fighters. These aircraft were operational on all fronts and eventually tipped the scales in the struggle for air superiority, and hence in the outcome of the war.

History has recorded how American (and British) industry "out-produced" the German and Japanese resources: Against the 300,000 American and 125,000 British aircraft manufactured during the war years—a large percentage of which were multi-engined bombers—the German and Japanese industries were only able to counter with relatively insignificant replacement batches. The war in the air was not won by a "Breadth of Armament" as manifested in the

1937: Potez 63 three-seat fighter-bomber (two 670-h.p. Gnome Rhône 14 Ms).

1938: Douglas DB-7 medium bomber (two 920-h.p. Pratt & Whitney *Twin Wasps*).

1937/38: Boeing XB-15 *Super Flying Fortress* heavy bomber (four 1,000-h.p. Pratt & Whitney *Twin Wasp Seniors*); crew 7 to 9.

1939 — 1945

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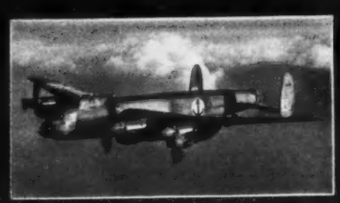
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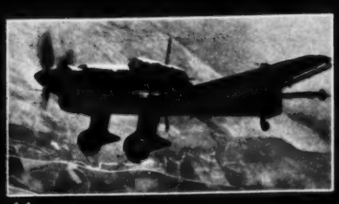
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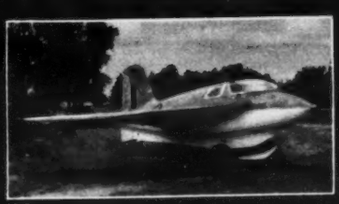
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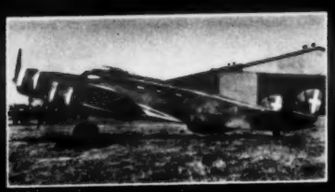
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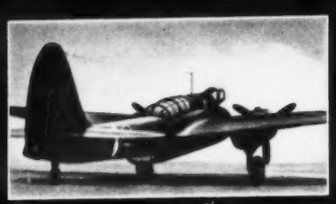
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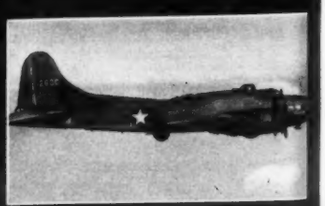
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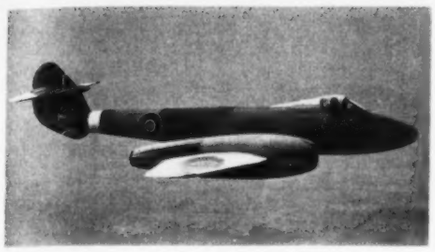
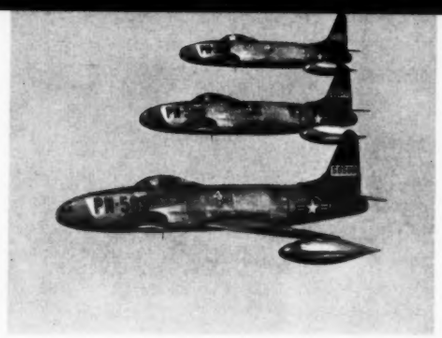


1945/46: Gloster *Meteor F.Mk.3* jet fighter (two Rolls-Royce *Derwents*).



1947: Lockheed F-80B *Shooting Star* was the first U.S. jet fighter to be produced in large numbers.

1948: North American F-86A *Sabre*, first U.S. swept-wing jet fighter.

Great Britain

1: Vickers-Supermarine *Spitfire V*.
2: Hawker *Typhoon I B*.
3: Bristol *Beaufighter I* day and night fighter.
4: Vickers *Wellington III* night bomber.
5: Short *Stirling I* heavy night bomber.
6: Handley Page *Halifax VI* heavy bomber.
7: Avro *Lancaster I* heavy bomber, here shown in French Navy markings.
8: De Havilland *Mosquito B.IV* intruder and long-range reconnaissance aircraft.

Germany

9: Messerschmitt Me 109G day fighter.
10: Focke-Wulf Fw 190A day fighter.
11: Junkers Ju 87D dive bomber.
12: Multi-purpose Junkers Ju 88A-4.
13: Heinkel He 111H day and night bomber.
14: Multi-purpose Dornier Do 217E.
15: Messerschmitt Me 163B rocket powered short-range interceptor.
16: Twin-jet Messerschmitt Me 262B-2 day and night fighter.

Italy

17: Fiat G.55 day fighter.
18: Savoia-Marchetti SM.84 day bomber.

Japan

19: Nakajima Ki 442 (Tojo) day fighter.
20: Kawasaki Ki 482 (Lily) light bomber.
21: Mitsubishi G4M1 (Betty) medium bomber.

Soviet Union

22: Yakovlev Yak-9 day fighter.
23: Ilyushin Il-2 strike fighter.
24: Petliakov Pe-2 multi-purpose combat aircraft.

USA

25: North American P-51D *Mustang IV* escort fighter.
26: Republic P-47B *Thunderbolt* escort fighter.
27: Lockheed P-38J *Lightning* escort fighter, and fighter-bomber.
28: Lockheed B-34 *Ventura* medium bomber (Navy designation PV-1).
29: North American B-25 *Mitchell* medium bomber.
30: Boeing B-17E *Flying Fortress* heavy day bomber.
31: Prototype of the Consolidated Vultee B-24 *Liberator* heavy day bomber.
32: Boeing B-29 *Superfortress* heavy day and night bomber.

numerical total of first-line aircraft available at the beginning of the war, but rather by a "Depth of Armament"—the capacity of the aircraft industries to design and produce a steady stream of the proper tools at the right moment and in adequate quantities. For example, the Americans' tightly-packed fleets of heavily-armed day-bombers were not invulnerable, and were forced to accept fairly heavy losses especially over Germany, until industry came up with the solution in the form of the long-range escort fighters (Republic P-47 *Thunderbolt* and North American P-51 *Mustang*).

After the collapse of Germany the second World War came to an abrupt end when the Boeing B-29 strategic bomber loosed its atomic bomb load on to Hiroshima and Nagasaki. The master mind behind the United States Army Air Force at the height of its power had been General Henry H. (Hap) Arnold, who had paved the way for the recognition of the U.S. Air Force as an independent arm in 1947.

*

Japan also followed a policy of dividing her air strength, and gave preference to the naval air arm as the tool of her seapower. When Japan launched into war in the Pacific in December 1941, her first-line strength totalled approximately 3,000 aircraft of all categories. The available aircraft carrier fleet totalled five ships, but these were supported by a number of auxiliary carriers and converted merchantmen equipped to handle seaplanes.

After the success of her first surprise attacks, the air assault on Pearl Harbor and a completely unexpected overland march against Singapore, the Japanese found to their dismay that their aircraft carriers were being sunk one after another by the United States Navy aircraft. Gradually wearing down the enemy's resistance, the Allies pushed through a crushing counter-offensive, leap-frogging from island to island to give both their tactical and strategic air forces the bases from which they could bring increasing weight to bear. The two atomic bomb attacks on the Japanese mainland only served to shorten the death struggles of an already technically beaten Army and Navy, then without any form of air cover, and a hopelessly out-classed and overtaxed armaments industry.

*

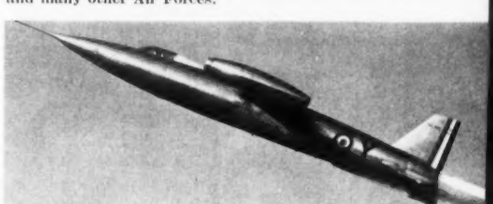
1948/49: MiG-15, later to be the Russo-Chinese Air Forces' main weapon in Korea.

1950/51: Sweden undertook her own fighter development and produced the Saab-29.

1955: Hawker *Hunter*, standard fighter with the RAF and many other Air Forces.

1955/56: A supersonic fighter for the Armée de l'Air: Dassault *Super-Mystère B-1*.
1958: Lockheed F-104A supersonic fighter: Mach 2+ with almost 7 tons thrust.

1958: Fiat G.91, light strike fighter, built to NATO specifications.
1957/58: English Electric P.1B – the last of the RAF manned interceptors?



1955: SO.900 *Trident I* with SEPR rocket motor and two Dassault MD.30 *Viper* auxiliary jet units.
1957/58: The Swedish supersonic formula... Saab-35 *Draken* with double delta wing.

A quarter century

Diagram A: **The development of fighter speeds over the last 25 years**

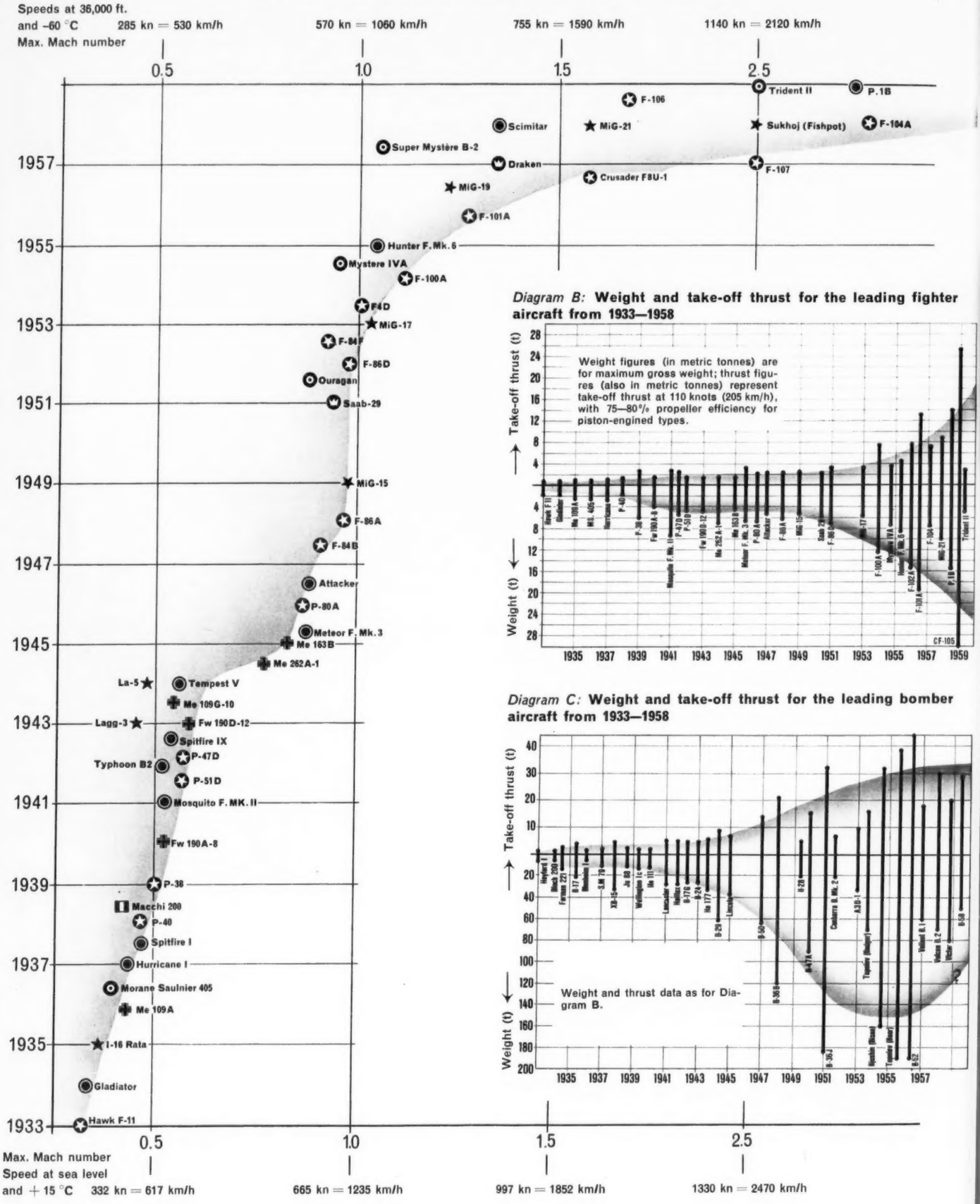


Diagram B: **Weight and take-off thrust for the leading fighter aircraft from 1933—1958**

Diagram C: **Weight and take-off thrust for the leading bomber aircraft from 1933—1958**

USA
SOVIET UNION
FRANCE
GREAT BRITAIN
GERMANY
ITALY
SWEDEN

1958/59: Handley Page *Victor* V-bomber, future H-bomb carrier of the RAF.

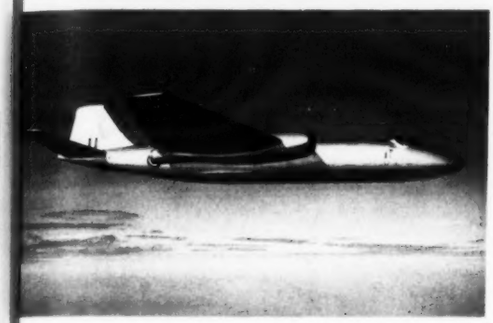
1951/53: English Electric *Canberra* tactical bomber and high-altitude reconnaissance aircraft.

1950: The Boeing B-47 jet bombers have been the main U.S. strategic weapons for many years...

1949: Ilyushin Il-28 tactical bombers are stationed on all Soviet Union frontiers.

1954: ...and the four-jet Ilyushin *(Bison)* the backbone of the Red bomber fleet.

1954/55: Sud-Aviation SO.4050 *Vautour* tactical bomber and all-weather fighter.



But probably the biggest surprise of the war was the utterly negative role played by the *Russian* Air Force. Although in pre-war days the Soviet Union had been generally credited as being the nation possessing the largest fleets of multi-engined bombers and hundreds of thousands of highly-trained parachute troops, neither of these trump cards was played. It is possible that the greater part of the Russian bomber groups were destroyed on the ground in the Luftwaffe's initial surprise attacks, but whatever the reason, the long-drawn-out ground war in the East was fought out almost as if the bomber had never been invented. Both sides restricted themselves to the employment of ground attack aircraft and fighters in direct support of the ground forces. Not one Russian bomber showed itself over Germany, and the Siberian armaments arsenal remained beyond the reach of German bombers. It would clearly be foolish to attempt to draw any far-reaching conclusions from these facts, for history will certainly not repeat itself. The Russians have learned from their mistakes and today have one of the most powerful, centrally controlled strategic air arms, equipped with the most modern bombers and rocket weapons. Albeit somewhat late in the day, the Soviet Union has finally accepted Douhet's doctrines of air war.

The bloody years of the second World War which beset Europe and the Far East have brought sweeping changes in the international situation. In place of the seven pre-war major powers, each with its individual foreign policies and interpretation of armaments requirements, there are now only two "super-powers", both haunted by the fear of a surprise attack such as those on Russia on June 22nd, 1941, and on Pearl Harbor on December 7th, 1941.

Diagram A: From 1933 to 1940 fighter speeds showed a steady increase up to a temporary maximum of approximately 390 knots (725 km/h); this limit was passed with the introduction of jet types in late 1944—early 1945. It was not until swept-wing jet fighters (F-86A, MiG-15, etc.) were introduced that the sound barrier was reached. For many years maximum level speeds remained in the high subsonic bracket until, in 1954, the F-100 broke through to supersonic speeds. New developments in aerodynamics and the considerably increased performance of jet engines have permitted a rapid succession of advances to Mach 2 and above.

Diagram B: Thrust-to-weight ratio in 1933 fighters barely reached 1 : 3 but improved to 1 : 1 for modern jet aircraft at speeds around Mach 2. In propeller driven aircraft thrust (at a given altitude) decreases as speed increases, assuming constant engine output; whereas in jet aircraft thrust increases above a certain speed. The diagram also shows the trend towards greater gross weights; for example, interceptors with a relatively short endurance can today weigh as much as 15 tons.

Diagram C: Bombers also show a general increase in weight, although the tendency is not so universal as in fighters, and the trend appears to have swung back in recent years. The influence of modern guided missiles on bombing planning is clear. The B-58 *Hustler* supersonic bomber is roughly comparable to the CF-105 supersonic fighter as regards gross weight, power loading and speed.

1958: Avro CF-105 supersonic weapons carrier with more than 30 tons take-off weight; speed Mach 2+.

1958: Convair B-58 *Hustler*, a multi-purpose weapons system for intercontinental use on the edge of space.

A Quarter Century of Aeronautical Research, Development and Production

Science as Basis of Aviation

By Professor J. Ackeret,
Federal Institute of Technology, Zurich

Many scientists and engineers in all countries have been engaged in aeronautical research during the past quarter century. But only a relatively small group of men, whose names often have not reached the general public, can claim to have done pioneering work. They include Professor Jakob Ackeret, of the Federal Institute of Technology, Zurich, who celebrated his 60th birthday in March. A disciple of Ludwig Prandtl, he introduced the Mach Number into aerodynamics in 1928 and built the first closed-circuit supersonic wind tunnel in 1933—34. *Interavia* readers will undoubtedly appreciate an introduction to the story of aeronautical engineering of the past 25 years from the pen of so eminent an authority. Editors.

Fifty years after the first powered flight a number of experts attempted to forecast the development of flying (and space travel) in the next fifty years. The result was an admission that though everything is possible, nothing is certain. But even 25 years is a long time for prophecies and retrospects. We need only read over the back issues of *Interavia's* publications to realize not only how many correct predictions were made but also how many surprises there have been. How did this come about?

Without underestimating the results achieved in building and flying, it can be said that basic progress has been attributable in the first place to the achievements of science. And we should be very much surprised if this state of affairs should change in future.

In my sketch of the activities of the aeronautical sciences during the past 25 years, I should like to restrict my remarks to *aerodynamics* and *propulsion* ... for the simple reason that I do not feel competent to talk of the many other, equally important branches—such as stress analysis, aero-elasticity, radio engineering, materials, meteorology, navigation, aeronautical medicine, etc. And even within my chosen field I must make a fairly arbitrary choice of items, as otherwise the result would be nothing but a long and tiresome list of names and dates[1].

Aeronautical science began to come to the fore as early as World War I. Men like *Ludwig Prandtl, Th. von Karman* and their many colleagues gave aerodynamics the form needed for practical applications. The promising theory of potential flow hydrodynamics, developed during the last century (and worthily evaluated in Lamb's book) was at first of only limited application to the problems of powered flight. The introduction of the *boundary layer* and *wing theories,* the clear assessment of the *similarity conditions* for model tests, and the recognition of the role of *turbulence* (G. I. Taylor and H. Dryden) laid the groundwork for the practical calculation of aircraft designs. *Albert Betz* applied the new knowledge with great success to *propellers,* whose modus operandi at last became clear. The problem of *wing flutter,* which could at times be really malevolent, was explained by the pioneering work of *W. Birnbaum,* whom death removed too early from the field, and whose discoveries enabled this troublesome phenomenon to be calculated accurately. On the other hand the development of aircraft engines has always been a matter of trial and error, and the piston engine—like the steam engine—seems likely to die out without its theory being entirely mastered: flow, combustion, heat transfer and lubrication, being non-stationary processes, are too hard a nut for the theoretical scientist to crack, even in the age of electronic computers.

The aeronautical sciences were on a firm foundation as early as 1930, when it was almost possible to design an aircraft "from the book". But subsequent years brought a change in emphasis. Above all, military requirements were pressing for rising speeds, in which the burgeoning air transport industry also revealed an interest. *Mach Number* became a current unit for the measurement of speed, and the attainment of *Mach One,* namely a speed equivalent to that of sound, was aimed at as a far-off goal.

This is the moment to mention the memorable *Volta Congress of 1935,* organized and directed in Rome by Italy's gifted and enthusiastic *General A. Crocco.* For the first time the problems of high-speed flight were surveyed on a broad scale, and the still somewhat puzzling experience of the new supersonic wind tunnels announced. A new unknown took the stage, the *compressibility of air.*

One result of the wind tunnel experiments was particularly frightening: the tremendous *rise in drag* even before the speed of sound was reached. The difficulties involved in increasing the power of piston engines and the fatal loss of propeller efficiency at higher Mach numbers led some Congress delegates to quote the despairing words of the "Divine Comedy": "Lasciate ogni speranza... abandon hope." Only *Busemann* was undismayed: "*Make your wings as thin as razor blades and sweep them back!*" He should have added: find a much more powerful form of propulsion than the piston engine/propeller combination can provide.—Actually, the necessary form of propulsion was already on its way. *Maurice Roy* (today head of ONERA, Paris), in particular, pointed to the capabilities of pure *jet propulsion.* The first requirement, of course, was gas turbines, then in their infancy.

[1] The reader will find the history of aerodynamics treated in masterly and attractive fashion in Theodore von Kármán's "Aerodynamics—Selected Topics in the Light of their Historical Development". Cornell University Press.

The Royal Aircraft Establishment's huge subsonic and supersonic wind tunnel at Bedford for Mach numbers from zero to 2.8 (excluding transonic range) has an 8 × 8 ft. working section and requires blower powers of up to 80,000 h. p., or 60,000 kilowatts; completed in 1957; estimated cost roughly £12,000,000.

Supersonic section (foreground) and transonic and subsonic sections (behind) of the Cooperative Wind Tunnel in Pasadena, California: blower powers up to 40,000 h. p., or 30,000 kW; max. Mach number 1.8.

1933: SBAC Display at Hendon: Still many biplanes of all categories... among low-wing monoplane sports aircraft (with fixed undercarriage) and high-wing amphibians (with lifting wheels).

1936: 15th Paris Air Show: The biplanes have disappeared, and a number of low-wing monoplanes with retractable undercarriage have made their appearance: e. g., Holland's Fokker G.1 ground attack aircraft (with double fuselage); next to it, France's Loire-Nieuport 250 single-seat fighter; Russia's Tupolev 35 commercial transport, etc.

Another, basically ancient, form of propulsion, the *rocket*, was also discussed in Rome, though somewhat hesitantly. In this field *Ziolkovski, Oberth* and *Goddard* had done pioneering work, with the then completely fantastic goal of travelling to the moon and the planets. But there was one thing that nobody had foreseen—not even Oberth or the intrepid *E. Sänger*—namely that *nuclear energy* would become available for technical utilization within the relatively near future.

The past 25 years have brought us further than even the most far-sighted writers could have imagined. Today we have all the necessary aids: thin swept wings, jet engines of unbelievable power, rockets of all sizes. The "sound barrier" has been pierced, and there are already aircraft which fly faster than rifle bullets. Artificial satellites are circling the earth. We are on the threshold of the production of atomic powerplants for aircraft... only a few "minor difficulties" still remain to be overcome.

Science is making more powerful efforts than ever before. Our wind tunnels have developed into immense installations, with powers of a hundred thousand kilowatts or more. The transonic range, which earlier was very imperfectly understood and presented forbidding experimental difficulties, has been thoroughly investigated. Whereas at one time the main emphasis was on pure mechanics, today aerodynamics has entered the realm of physics to an astounding degree. At the high Mach numbers attained today, the air becomes dissociated and ionized, and there are already projects for controlling it in this electrically conductive state by means of magnetic forces. In the subsonic range boundary layer control through suction (laminarization) has had some very promising results. At present new methods of propulsion—ion and plasma radiation, free (frozen) radicals—are being investigated, with a view to bringing interplanetary travel within the bounds of possibility. *Wernher von Braun* considers that such advances into space are practicable "in principle" even with present resources. And the suggestion has already been put forward that the "obsolete" Mach Number should be replaced by a "Lorentz Number" or "Einstein Number"... whose denominator is the speed of light.

The older generation should not be altogether blamed if they sometimes shudder at the thought of such ventures. "Space travel is an enormously costly sport and therefore an extravagant luxury which contributes nothing to human happiness, safety or satisfaction," writes the well-known atomic physicist *M. Born*. But those who have read *Interavia* during the past few years will agree with me that there are other ways of looking at these things. In my opinion, the curse of our age lies less in our technical progress, but in our frightening relapses into primitive times: the lust for power or for conquest, intolerance, intellectual barbarity. These and other atavisms must be overcome by a constant educational effort. *Aviation, which is making the world smaller every day, has an eminently important task to perform in this very direction.*

T. Sakell

The Ups and Downs of the Aircraft Industry

From a modest series of enterprises employing less than 100,000 persons (throughout the world) in the early thirties, the production of aircraft, helicopters, missiles, and their powerplants, equipment and ground aids has grown during the past quarter century into a mighty branch of industry which now provides a living for some 2½ million men and women[2]. Only about one fifth of these persons—roughly 500,000—are working on peaceful projects, for the airline fleets or charter and sports flying... the other four fifths hope that they are helping to prevent war through their armament efforts. It is therefore understandable that the aircraft industry's labour force should, like a fever chart, have indicated the temperatures of the various cold and hot wars of the past 25 years. Sudden jumps of 100 or even 200 percent in employment figures from one year to another have been by no means rare. On the other hand, the immediate cut-back in production after the war—to less than a fifth of the peak wartime output—persisted in the American and British industries... until the shock of the Korean War.

The world's aircraft industry reached its absolute peak strength in 1944, with more than eight million employees. Of these, the United States, Britain and the Soviet Union constributed roughly 2,000,000 each[3], Germany and Japan probably one million each. During World War II, the Americans built some 300,000 military aircraft, the British 125,000, the Germans around 110,000.—No reliable figures are available for the other belligerent countries, though it can probably be assumed that both the Japanese[4] and the Russians each built at least 100,000 aircraft. The Russians have always maintained a strong aircraft industry, which was estimated as employing roughly 17,000 workers in the airframe plants and 7,000 in the engine plants in 1933, that is, more than twice as many as the American industry (9,600 employees according

From the research laboratory: shock wave of a nylon "golf ball" moving at 17 times the speed of sound through a highly rarified xeon atmosphere: gas temperatures of more than 6,000 °C occur at the front (U.S. Navy photo, from the White Oak, Md. Naval laboratory).

[2] In 1957 the fifteen leading aircraft industries employed the following staffs: 1 – Soviet Russia more than 1,000,000; 2 – USA 750,000; 3 – United Kingdom 280,000; 4 – France 80,000; 5 – Canada 50,000; 6 – Germany, West approx. 5,000, East approx. 15,000; 7 – Japan 16,000; 8 – Czechoslovakia approx. 15,000; 9 – Australia 11,000; 10 – Sweden 10,000; 11 – Italy 8,000; 12 – Spain 8,000; 13 – Holland 7,000; 14 – China (not known); 15 – India (not known).

[3] "Aviation Facts and Figures" (1956 edition) gives the following mean figures for the USA in 1944: airframe industry 815,000; engine industry 340,000; equipment industry 142,000; subcontractors 650,000; total 1,947,000 men and women. – In his opening speech to the 1946 SBAC Display, Sir William Reginald Verdon Smith, SBAC President, said: "... eight long years of war have passed since the Society's last Display. During that time the manufacture of aircraft became Great Britain's largest industry, some 15,000 undertakings were engaged at the peak of our effort utilizing the services of no fewer than 1,820,000 men and women. We built 125,000 aircraft, made spares equivalent to another 87,500 aircraft and repaired and put back into service no fewer than 80,000."

[4] Between the wars (1918 – 1941) the Japanese industry turned out roughly 100,000 aircraft and 150,000 engines; total output for 1944 was 24,000 aircraft and 40,000 engines.

to AIA). Today the less extensively mechanized Russian aircraft industry probably employs more workers than the American, Canadian, British and French industries combined.

A review of the leading aircraft manufacturers in the West—and these are the only companies on which reliable reports are available—reveals roughly the following picture:

USA:

7 giant manufacturers with more than 40,000 workers: Bendix Aviation Corporation; Boeing Airplane Company; Convair Division of General Dynamics Corporation; Douglas Aircraft Company; Lockheed Aircraft Corporation; North American Aviation Inc.; United Aircraft Corporation.

9 large undertakings with more than 20,000 employees: Aerojet-General Corporation; Bell Aircraft Corporation; Curtiss-Wright Corporation; Aircraft Gas Turbine Division of General Electric; Hughes Aircraft Company; The Martin Company; McDonnell Aircraft Corporation; Northrop Aircraft Inc.; Thompson Products Inc.

22 companies with more than 5,000 employees: AiResearch; Beech; Cessna; Chance Vought; Collins; Fairchild; Ford; General Precision Equipment; Goodyear; Grumman; Hayes; Federal (IT & T); Lear; Lycoming; RCA (Electronics); Republic; Rohr; Ryan; Solar; Sperry; Temco; Westinghouse.

CANADA:

4 companies with more than 5,000 employees: Avro Aircraft Ltd.; Canadair Ltd.; Canadian Pratt & Whitney; Orenda Engines Ltd.

GREAT BRITAIN:

6 large undertakings with more than 20,000 employees: The Bristol Aeroplane Company; Hawker-Siddeley Group Ltd.; Bristol-Siddeley Engines (new company); de Havilland; Rolls-Royce Ltd.; Vickers-Armstrongs (Aircraft) Ltd.

10 companies with more than 3,000 employees: Alvis; Blackburn; English Electric; Fairey; Folland; Handley Page; Napier; Saunders-Roe; Short; Westland-Normalair.[5]

FRANCE:

1 large company with more than 20,000 employees: Sud-Aviation.

7 companies with more than 3,000 employees: Breguet; Le Groupe CSF; Dassault; Hispano Suiza; Nord-Aviation; SNECMA; Thomson-Houston.

[5] Plus 8 major electronics firms working only in part for the aircraft industry: Cossor; Decca; EKCO; Mullard; Murphy; Pye; Solartron; Standard T. & C.

1939: Igor Sikorsky's first successful helicopter, the VS.300 (with its designer in the cockpit), opens up a new branch of production in the aircraft industry.

Since then other new categories of aircraft have joined the helicopter: pilotless self-guiding bombers *(below)*, such as the Northrop *Snark* and the Martin *Matador* (both with jet engine and auxiliary rockets)... VTOL and STOL aircraft *(above,* the Breguet 940 with four propeller turbines and slotted wing).

OTHER COUNTRIES IN WESTERN EUROPE:

8 companies with more than 3,000 employees: ACEC (Belgium); Fiat Aviazione (Italy); Fokker (Holland); Philips (Holland); MBLE (Belgium); Saab (Sweden); SABCA (Belgium); Telefunken (Germany).

Roughly 60 percent of all employees in the Western aircraft industry are engaged on airframe construction (for aircraft or missiles), with the remaining 40 percent being roughly equally divided between the engine manufacturers and the equipment industry. Many large companies—such as North American, United Aircraft, de Havilland, English Electric and the Hawker-Siddeley Group—are active in all three sectors. It should be stressed that the supreme production responsibility for a finished military or civil product generally rests with the airframe manufacturer, in particular since the weapons system concept—aircraft, armament, equipment, ground equipment forming a complete whole—has become generally accepted for military materiel. At the present time most of the above-mentioned companies are working on designs of their own and must therefore be described as "development companies", which however does not prevent a large portion of their production capacity at times from being devoted to building other company's designs under licence or producing components for other companies.

From hand work to large-scale production

The most spectacular changes during recent decades have of course been made in airframe manufacture. Not only have the power and gross weight of conventional fixed-wing aircraft increased to 30 to 60 times the earlier mean values for each aircraft category, not only have aerodynamic shapes been radically altered through the introduction of jet propulsion, but also entirely new categories of air vehicles have made their appearance: *helicopters* (some 6,000 in service throughout the world today); *aerodynamic and ballistic missiles* with jet, ramjet or rocket propulsion; *VTOL and STOL aircraft, etc.* The rapid rise in speeds led to the traditional demands for light weight and safety being joined by the new requirement for the utmost *precision* in external configuration and rational *heat resistance* in structural materials. Surface imperfections of as little as one permille of the wing thickness in a high-speed aircraft are a serious handicap for the latter's performance, and every millimetre ($^1/_{25}$

The de Havilland plant in 1933 and 1956: From the all-wood *Gipsy Moth* to the all-metal *Dove* (middle row) and *Venom* (left-hand row).

inch) cut from the thickness means a weight saving of 0.58 lb. per square foot of surface in the case of aluminium alloys, of 0.92 lb. in that of titanium alloys and of 1.65 lb. in that of steel. Today's supersonic fighters already use some 600 lb. of titanium materials, and the chief material for high-speed aircraft in the sixties promises to be stainless steel.

Back in 1933 a designer could still content himself with making a rough estimate of the air and mass forces to be expected in flight and distributing them by the methods employed in bridge building among the various structural members, whose dimensions were then determined. But only a few years later it was discovered that air forces and deformations in high-speed aircraft formed an inseparable whole, as air forces can be multiplied under the influence of deformations or—as in the case of control surface reversals—disappear entirely. This discovery was the beginning of today's universally recognized theory of aero-elasticity, which in recent years has again had to be extended, through the advent of frictional heating problems, into a kind of "aero-thermo-elasticity theory". Similarly, in engine design—for example, in the dimensioning of turbine and compressor blades—the combined thermal and mechanical stressing of structural parts is of the utmost importance.

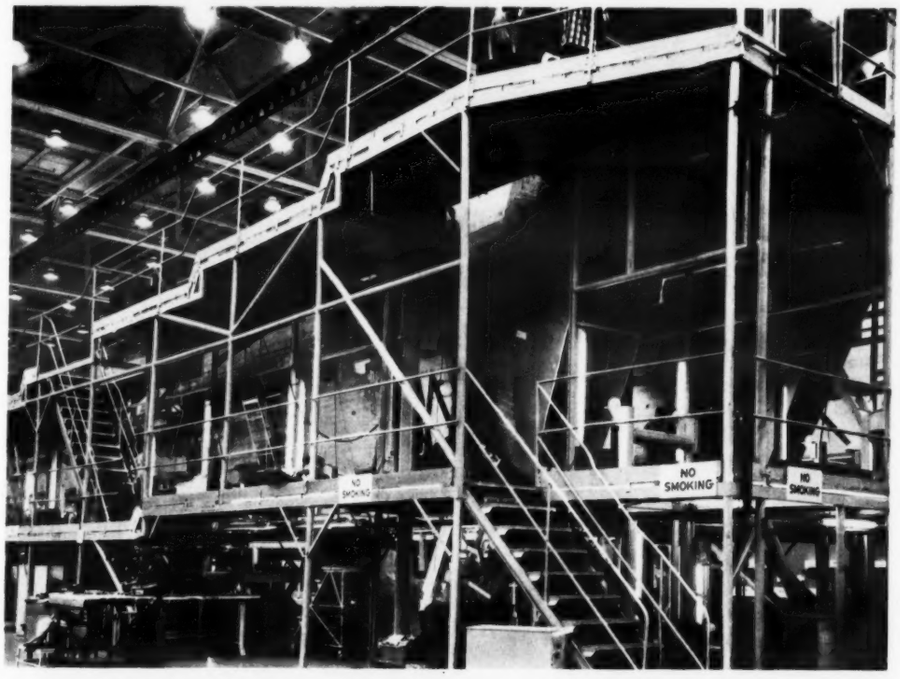
As speeds, size and production numbers of aircraft grew, so *design methods* also changed: for many years mixed construction (all-wood wing, steel tube fuselage framework, fabric covering) held sway and was only gradually displaced by the more rugged and weather-proof light metal constructions. To a growing extent the stiffened metal skin replaced the earlier grid design composed of individual rods, until finally most aircraft were of monocoque construction, and this production method was developed, in recent years, into the integral stiffening and sandwich systems.

Changes in design naturally led to corresponding changes in *production processes,* to the machining of integral plates for wings and tailplanes on giant, programme-controlled milling machines, or chemical milling in acid baths; super-heavy presses for shaping components (today with pressures of up to 50,000 tons, and a column length of more than 100 ft.); transfer machines for the quantity production of complicated parts; time-controlled assembly lines. All this combined with extensive division of the complete article into finished, readily exchangeable sub-assemblies, with a growing number of special tools and jigs of all sizes . . . hence with standardization, rationalization and automation. While aircraft manufacture in the early thirties was still more or less an artisan affair, today's production of all-metal aircraft, for both military and civil customers, is the domain of the big industrial plant, if only because of the costly installations and the complicated organization of labour which it requires.

The engine power race

To begin with, the piston engine dominated the field, in the form of the air-cooled radial engine in commercial aircraft and bombers, or the streamlined V (W or X) engine with liquid cooling in the majority of high-speed fighters. By progressive increases in rev. speed and the introduction of reduction gears between engine and propeller shafts, by direct injection of the fuel into the cylinders and the supply of combustion air under pressure (high-speed turbo-blowers),

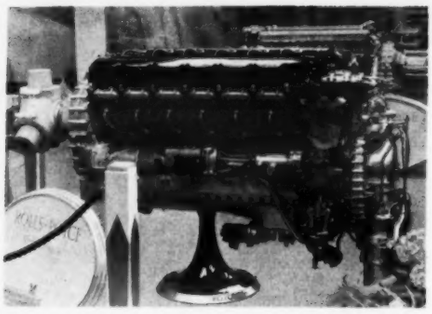
Super-heavy presses, such as this 8,000-ton monster at Lockheed, and programme-controlled skin milling machine with 40-ft. travelling table (also photographed at Lockheed) machine the integrally stiffened components of today's civil and military aircraft.

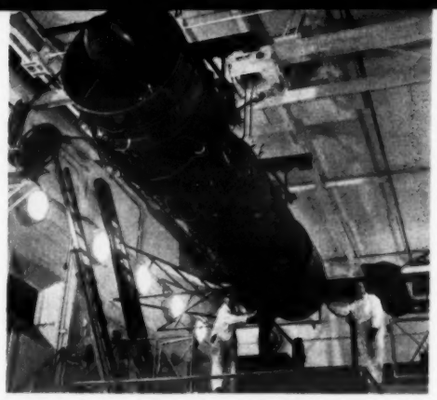


Assembling wings of a Douglas DC-8 in a three-storey rig.

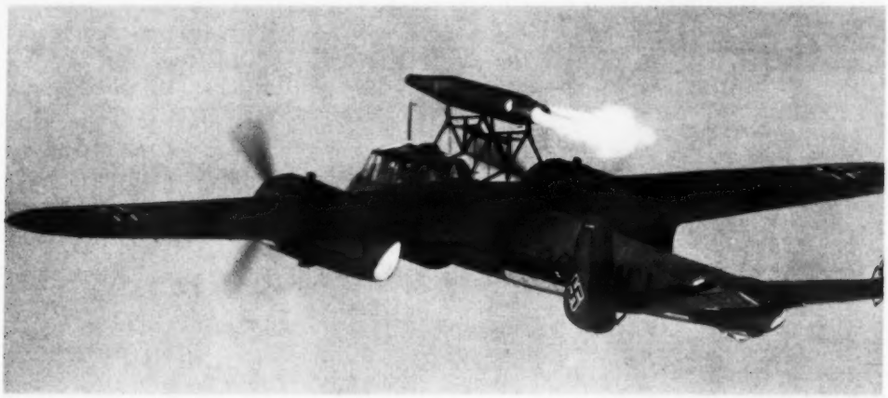
The third production Boeing 707 leaves the Transport Division's final assembly shop at Renton, near Seattle.

A quarter century

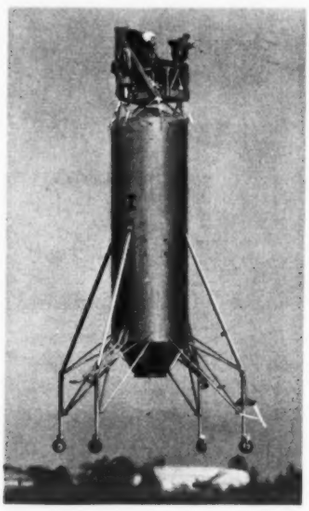


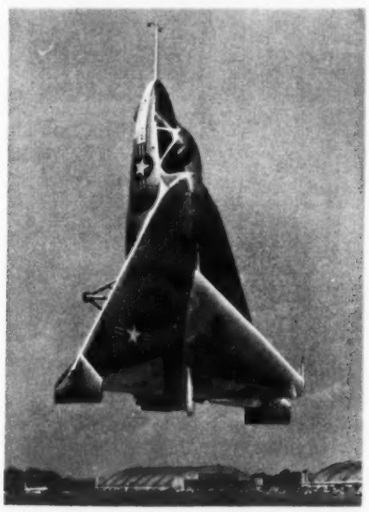


A quarter century of engine development: From the 12-cylinder Rolls-Royce *Merlin* (power class 1,000 to 1,600 h. p.), which was fitted, for example, in the British *Hurricane* and *Spitfire* fighters, to today's most powerful fighter engine, the Orenda Engines *Iroquois*, with a thrust (with reheat) of some fourteen tons and destined for the Avro CF-105 twin-jet long-range fighter.



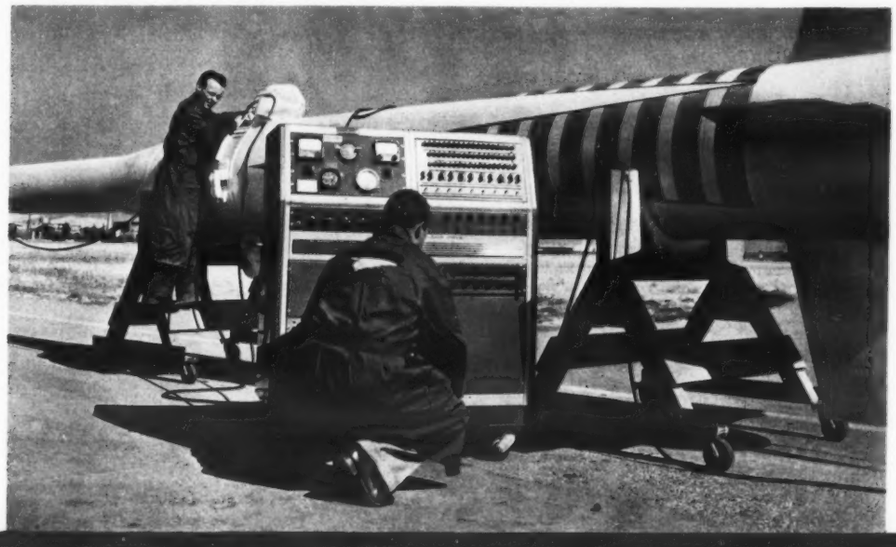
From the archives of Dr. Eugen Sänger: Supersonic ramjet, some 20 ins. in diameter, operating at subsonic speed (1941, in a Dornier Do 17 Z flying test bed).





The high power/weight ratio of modern jet engines and a very lightweight airframe permit vertical take-off: *left*, France's SNECMA *Atar Volant* (predecessor of a coleopter); right, the United States' Ryan X-13 *Vertijet* research aircraft.

Forward into cosmic space! Engineers checking the systems in the Lockheed X-17 three-stage research rocket, with which various models of re-entry bodies (nose of the final stage) have been tested.



and finally by the design of variable pitch propellers with optimum efficiency in all flight conditions, designers succeeded in constantly increasing engine take-off and combat outputs. For example, the Pratt & Whitney R-1830 *Twin Wasp* 14-cylinder two-row radial engine, pictured in *Interavia Correspondence No. 1* of April 3rd, 1933, and then the United States' most powerful engine, had a take-off rating of only 800 h.p. By 1945 the same engine was delivering 1,200 h.p., and its later development, the R-2800 *Double Wasp* with four extra cylinders, which today powers a large number of commercial transports (Convair 240, 340, 440; Douglas DC-6; Martin 404, etc.), has now reached 2,400 h.p. The same happened to the liquid-cooled engines, such as the Rolls-Royce *Merlin* (from the original 890/1,030 h.p. to 2,030 h.p. in the *Griffon* development) and the Allison V-1710 (finally 1,475 h.p.), to mention only these few examples.

Take-off powers of some 3,500 h.p., such as are attained for example by the Pratt & Whitney R-4360 *Wasp Major* 28-cylinder four-row radial, marked, however, the farthest limit to which piston engines could go. The aircraft designers' persistent clamour for ever greater propulsive power, combined with adequate propulsion efficiency in the transonic and supersonic ranges, could not be satisfied until turbojet, ramjet and rocket engines were introduced in aviation. The early patents and experimental machines of a *Whittle* or an *Ohain*, the pioneering thermodynamic work of *Lorin*, *Leduc*, *Paul Schmitt* and *Sänger*, the centuries-old pyrotechnic art, were developed patiently into the first practical turbojets, propeller turbines, ramjets and rocket motors. World War II encouraged this development, and the post-war arms race between West and East has carried it to a peak. Whereas an 800 h.p. engine of 1933 delivered a propeller thrust of only about one ton on take-off—and a good deal less in flight—today's most powerful jets with reheat provide some ten tons of thrust, ramjets up to 30 or 50 tons depending on Mach number, and rocket engines up to 100, 300 or even 500 tons.

This has carried the engine designers, who for decades had been the scapegoats for the airframe manufacturers, into the lead in aeronautical progress. Today they turn out giant supersonic turbojets, such as the 30-foot long de Havilland *Gyron* (with reheat) displayed at the last Paris Show, and have called forth fear and trembling among airframe designers, who scarcely know how to accommodate such monsters in their designs. The ramjet and combination powerplants now under development promise such extreme speeds that all known structural materials—even titanium, stainless steel and niobium—would be melted by the air friction in the lower layers of the atmosphere or would glow with a menacing red-hot glare. Beyond the "sound barrier", long overcome, looms the new obstacle of the "heat barrier", which cannot be pierced but only pushed back. Admittedly the fathers of the most powerful of all propulsion units—the rocket builders—are thinking primarily of cosmic space, where there is no substance to create a heat barrier . . . and have now only the problem of a safe return to earth to solve.

FIAT AVIATION

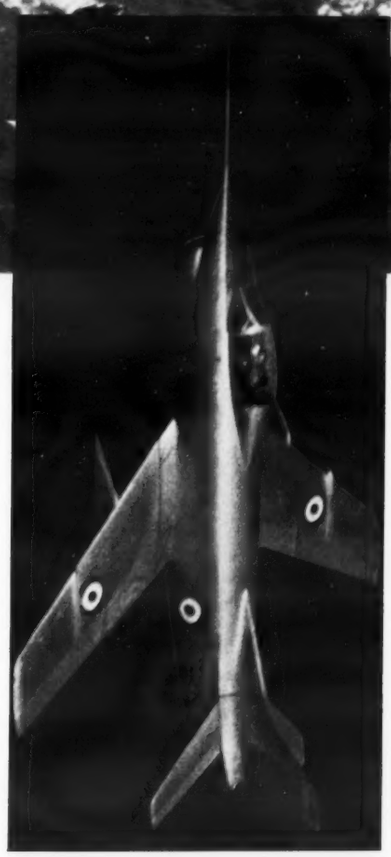
from 1908

The first FIAT aircraft engine SA8/75

to 1958 FIAT "G.91"

NATO LIGHT STRIKE FIGHTER

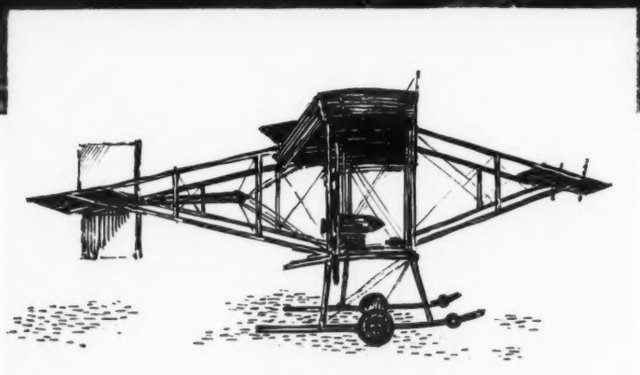
Capable of operating from grass strips or
semi-prepared runways, with very short take-off and landing —
Powerful and complete armament —
Ease of piloting, manœuvrability and safety —
Optimum accessibility for maintenance —
Low unit and operating costs —



FIAT — DIVISIONE AVIAZIONE

Corso Giovanni Agnelli 200 — TURIN (Italy)

COSTRUZIONI AERONAUTICHE
GIOVANNI AGUSTA



fifty years
of aeronautical
activity

COSTRUZIONI AERONAUTICHE **GIOVANNI AGUSTA**

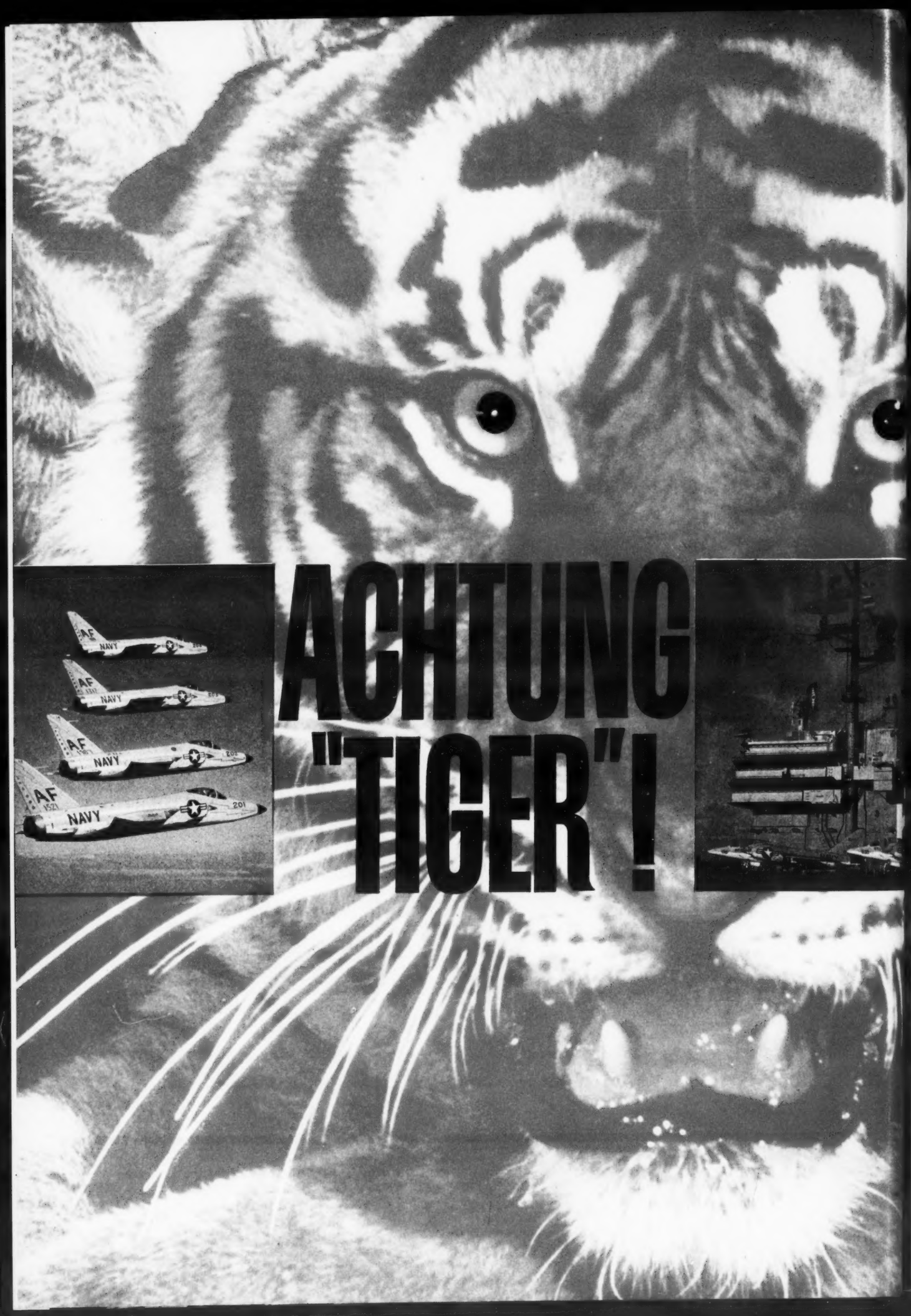
CASCINA COSTA (GALLARATE) ITALIA TELEGRAMS: AGUSTA-GALLARATE TELEPHONE: 21767-21768-21409-20109

The ENGLISH ELECTRIC
constant frequency generating
system has been selected
to provide electrical power
on Britain's latest V-Bombers

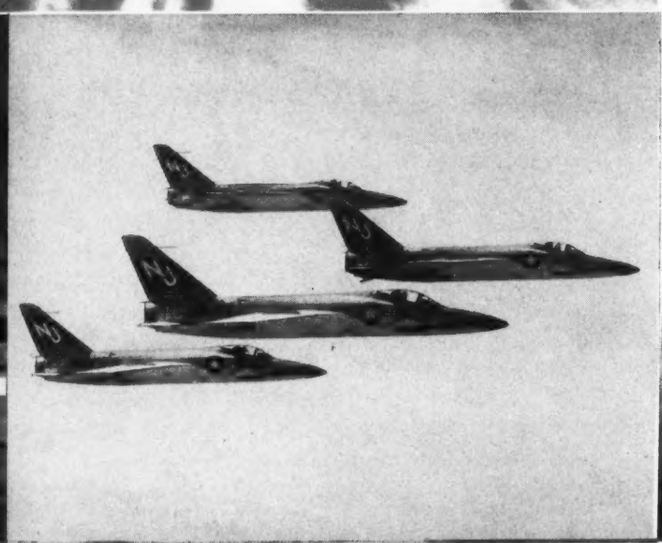
Constant frequency systems
for reliability, flexibility,
weight economy and fuel economy

'ENGLISH ELECTRIC'
aircraft equipment

THE **ENGLISH ELECTRIC** AIRCRAFT EQUIPMENT DIVISION, PHOENIX WORKS, BRADFORD

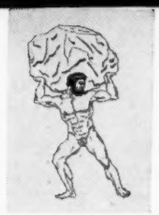

ACHTUNG
"TIGER"!
AF
NAVY
201
202

To date 146 Grumman Tigers have been delivered to the United States Navy. They have logged more than 15,500 squadron operational hours and are proving themselves most effective fighter-bombers. One reason is their high speed capability at low altitudes and excellent maneuverability. Cycling tests have proved that the Tiger wings have a 20 year fatigue life as a low level fighter-bomber.



The Grumman Super Tiger with the GE J-79 engine can fly at Mach 2 without any artificial stability augmentation and requires only 1,500 feet of landing roll to stop. Designed initially for aircraft carriers, the Super Tiger is the ideal fighter-bomber for short field operations.

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
Bethpage - Long Island - New York



Feats of Hercules

FROM THE SNOWS OF FUJIYAMA TO THE SANDS OF FLORIDA

The Lockheed C-130 HERCULES, now in service with the United States Air Force at Ashiya Air Base, Japan, won its "go anywhere, haul anything" reputation the hard way.

In snow landing and take-off tests at Bemidji, Minnesota, the "Ski-130" HERCULES performed prodigious feats of strength and power. At 124,000 pounds gross take-off weight the ski-equipped HERCULES was airborne in 2,100 feet. Carrying the same payload it landed and stopped in only 1,200 feet.

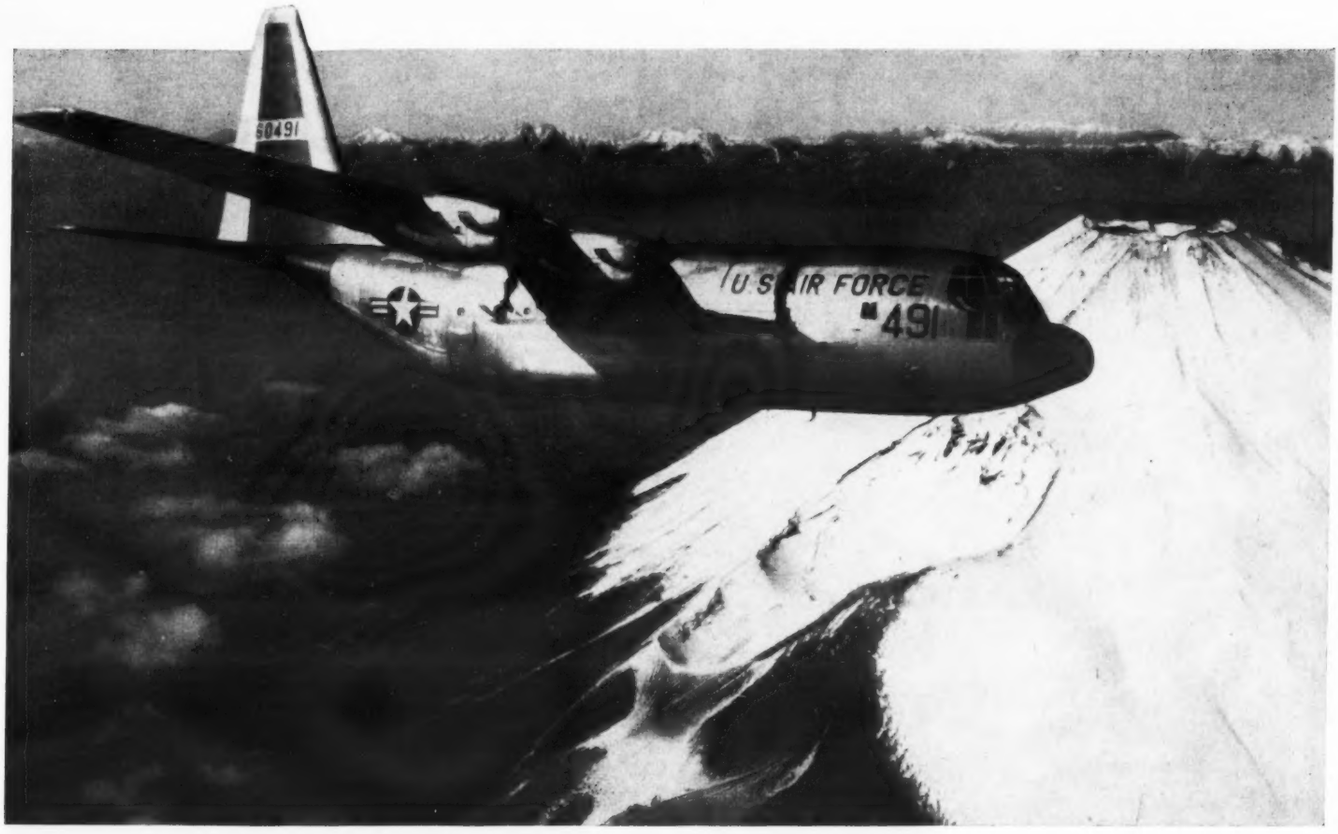
At Eglin Air Force Base, Florida, the C-130 HERCULES (weighing 110,000 pounds) landed on sand and stopped in 947 feet. Take-offs from sand, with the same load, averaged only 1,500 feet.

This famous aerial "strongman" can carry 90% of all types of missiles now operational with, and under development for, the U.S. Armed Forces. The C-130 HERCULES is now in world-wide service, or scheduled for delivery to: USAF's Tactical Air Command, U.S. Air Forces-Europe, Pacific Air Force, Air Photo and Charting Service, other branches of the U.S. Armed Forces, and the Royal Australian Air Force.

No matter where it goes—from the snows of Fujiyama to the sands of Florida — the C-130 HERCULES accomplishes the most rugged and difficult missions with routine ease.

Lockheed *means leadership*

Lockheed Aircraft Corporation · GEORGIA DIVISION · Marietta, Georgia, U.S.A.



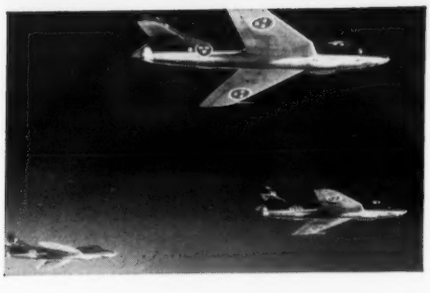
INTAKE TO THE FUTURE

Beyond this screen, which straightens turbulent air flows, Orenda can test run advanced engines in an atmosphere equivalent to 100,000 feet of altitude.

This new high altitude tunnel is another of the major programs at Orenda for research into air-breathing engines over the widest range of speed and altitude.

ORENDA *ENGINES LIMITED* MALTON, CANADA

MEMBER A.V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP



Hunters Defend SWEDEN

Speed, offensive power and great versatility have given the Hawker Hunter pride of place in many air forces of the free world, including that of Sweden. Today several squadrons of Hunters are in service with the Swedish air force, forging another sturdy link in the defences of Western Europe.
Hunters are also in service in India, Denmark, Holland, Belgium, Peru, Iraq — and now Switzerland.

HAWKER AIRCRAFT LIMITED Kingston-on-Thames, England
MEMBER OF HAWKER SIDDELEY / ONE OF THE WORLD'S INDUSTRIAL LEADERS

Geneva-

European Headquarters of the American Aircraft Industry

Aviation is big business, and like any other major industry the world's aircraft manufacturers have been quick to appreciate the necessity of getting close to their customers. Because of the national and international character of their interests, the major European companies are all to be found within easy reach in their London, Paris and Rome offices, and all the leading members of the U.S. industry maintain substantial staffs in the Federal Capital, Washington.

But Washington is a long way removed from the European market, and during the last few years a new American aviation centre has grown up, without ballyhoo and almost unnoticed by the outside lay-world, on the sunny shores of Lake Geneva. Today almost every self-respecting United States company is represented in Geneva, and the growth of this new corps of "commercial diplomats" in the old League of Nations city is an interesting study.

Representation in Europe was obviously essential, for not only was there a huge potential market for the American industry's products ranging from whole fleets of civil aircraft through all the associated equipment, but there was also a growing demand for on-the-spot technical and spares service, an increasing licence production interest, and, inevitably, a rising new military field.

But why Geneva?—the answers are only too obvious, and we may be pardoned for repeating them once again. A central position with good communications, a neutral location, political stability, hard currency and good tax concessions for foreign business interests, no rival national aircraft industry, the availability of multi-lingual office staff, and, by no means unimportant, a high standard of living with good housing, educational and social facilities.

Needless to say the Geneva authorities have welcomed this peaceful invasion; already the European seat of the United Nations, headquarters of the International Labour Office and many other international organizations, Geneva does everything in its power to encourage contacts between continents and nations. State Counsellor *Emile Dupont*, head of the Geneva Department of Commerce and Industry and also responsible for Geneva's international Cointrin Airport, has expressed his views in blacks and white in a letter to Interavia:

"Geneva, true to its tradition as meeting point, is proud of the contribution which it has been able to make towards the development of commercial aviation. This contribution is underlined by the establishment of its airport and by the heavy investment which the City, with the aid of the Federal Government, has again decided to make in the expansion of this airport.

Thanks to its excellent system of communications with all parts of the world, the City has been able to welcome to its territory the representatives of many aeronautical companies, who have chosen Geneva as the most suitable centre for their activities in Europe.

We should like to seize this opportunity of wishing INTERAVIA continued success in the service of aviation, in which we see a means of strengthening the peaceful bonds between the nations.

GENEVA, MAY 10TH, 1958

LE CONSEILLER D'ETAT CHARGÉ
DU DÉPARTEMENT DU COMMERCE
ET DE L'INDUSTRIE

Lockheed led the way. One morning in October 1945, shortly after the end of World War II, a sizable party of Americans arrived in Geneva, complete with bag and baggage, dependents and "highway battleships". Much of their baggage contained prospectuses, pictures and technical descriptions of the Lockheed 049 *Constellation*, the first four-engine airliner, then just becoming available. The delegation was headed by Sol Voorhees, who had been sent to Switzerland to open up the European market again. He stayed only a short time and was replaced by Austin MacInerny, a Lockheed veteran who, though young in years, was undoubtedly the most skilful and popular aircraft salesman any company could have sent over in the post-war period. But fate willed it that he should be one of the victims of the KLM accident at Prestwick in 1948. Nevertheless he had already succeeded in making the name *Constellation* into a household word in Europe, Africa and Asia. In 1954 C. F. C. Meuser took charge of the office, with Edward S. Fife, who had been sales engineer under MacInerny and had twenty years' service with Lockheed to his credit, as his deputy.

Meanwhile the Geneva sales staff was growing, and in May 1958 the Lockheed

Counsellor of State Emile Dupont, Head of the Geneva Department of Commerce and Industry.

organization in Europe was completely reorganized: *Guy H. Evans* became Director of Sales in Europe, Africa and the Middle East, *C. F. C. Meuser* Director of Special Projects for the region, and *Edward S. Fife* Director of Technical Sales. This triumvirate is seconded by Edwinston L. Robbins, until recently USAF Colonel attached to SHAPE in Paris and now Lockheed military representative; engineers Antoine J. Jansen and Blaine K. Stevens, and finally Harry H. Simons who represents the Georgia Division Export Sales Office. The Georgia Division is concerned primarily with the production and sale of the *Hercules* turboprop transport and the twin-jet *JetStar,* which Lockheed hopes to supply to Europe as military communications aircraft, executive transport, for aerial survey work, etc.

In addition to these two aircraft, the wide range of products which the Geneva organization is offering includes the *Electra* medium and short-range turboprop transport, and a variety of military equipment, such as the Lockheed F-104 *Starfighter,* the T-33 jet trainer and, sooner or later, the *Polaris* solid-propellant medium-range missile which would appear to fit into the NATO procurement programme.

Since the beginning of the year overseas sales have been the responsibility of Carl Haddon, Director of Marketing, California Division. Mention should also be made here of the enterprising public relations firm of Dolan and Bernhard, which works for Lockheed and has an office in Geneva.

*

The next American company of major importance to select Geneva as base for overseas expansion was *Douglas Aircraft Co.,* of Santa Monica, California. *M. (Mike) E. Oliveau,* a Douglas Vice-President who celebrated 25 years with the company in May 1958, took up residence in Geneva in 1952, bringing with him a wide experience of his market. A native of France, he went to the United States with his parents at the age of twelve, graduated from Antioca College, Ohio, joined Douglas Aircraft, and after the war opened the company's first European sales office, in Brussels, chiefly for spares. Both he and his wife Dorothy like Geneva, and four of their five children went to Geneva schools. Today he boasts of being six times a grandfather, but his 51 years and ceaseless travelling have left no marks on him.

Douglas aircraft—DC-3s, DC-4s, DC-6 series or DC-7 series—are today operating with practically every major European airline, seven of whom have also placed initial orders for a total of 30 DC-8 jet transports. The technical service and spares organization required to support these operations is obviously extensive, and the Douglas office in Geneva has a staff of twelve. *Kenneth McNeill* is Oliveau's immediate deputy, while Dick Baldwin and Jack Shaver are sales engineers, the latter for military equipment. The name of Don Stiess, Public Relations Manager, must also not be forgotten.

*

In Europe the name of *Boeing* is almost identical with that of *Kenneth J. Luplow,* Director of the company's European office in Geneva. He has been with Boeing since 1941, at first in flight testing and later in the sales department. He ran a Geneva office on a trial basis in 1948—49 and so has long been familiar with the city.

Boeing offered its 707 jet transport on the international market in 1955, and the next year the company decided to set up a full-scale office in Geneva. Luplow's sales staff includes *Hans W. Ott* as Assistant Director, *Robert C. Brumage* as European Engineering Representative, Thomas Weldon, as European Representative—Pilotless Aircraft Division, James Perrin as European Spares Representative and Percy A. Blackburn, late of the *Interavia* stable, as European Public Relations Representative.

The Geneva office is a focal point for the company's contacts with 60 airlines in 44 countries (21 in Europe, 12 in Africa and 11 in Asia), and it is not surprising to learn that the staff spends some 80 percent of its time travelling.

Luplow is directly responsible to Vice-President J. B. Connelly, General Manager of the Transport Division, Renton, Washington, and radiates optimism on the subject of his Boeing 707 and 720. Today aged around 40, he feels completely at home in Geneva, as do his wife and their four children, and he is certainly keeping his competitors on their toes.

*

Once Lockheed, Douglas and Boeing had settled in Geneva, *Convair* was not slow to follow. Since the war the San Diego company has won great successes in Europe with the twin-engine Convair 240, 340 and 440 *Metropolitan* and could obviously not be content

Guy H. Evans, Lockheed Director of Sales in Europe, Africa and Middle East, Head of the Geneva office.

C. F. C. Meuser, Lockheed Director of Special Projects for Geneva.

Edward S. Fife, Lockheed Director of Technical Sales, Geneva.

M. (Mike) E. Oliveau, Douglas Vice President and European Director.

to sit back and leave the jet field to others. Admittedly, the four-jet Convair 880 is something of a latecomer, compared with the Boeing 707 and Douglas DC-8, but Convair has carefully studied the market and undoubtedly has a successful sales record.

A small office was opened in Geneva at the beginning of 1957, under Lieutenant Colonel *Rolf Douglas Cape,* who joined the company straight from the USAF. In the late summer the office was moved to larger premises, and the staff expanded.

Manager of the European Office today is *George Cunningham Prill,* who came to Convair in 1956 after serving as Vice President of Capitol Airways, the largest of the U.S. independent operators, as member of the staff of the U.S. Civil Aeronautics Board, Secretary of the Engineering Committee of IATA and a member of the Engineering Department of Panagra and TWA. His second-in-command is Rolf D. Cape, assisted by Theodore Laven and Philip Lash Ward, both engineers, and between them the Geneva staff cover Western Europe, Africa and the Middle East. Their chief preoccupation is to get customers for the 880 which, Prill points out, could operate across the South Atlantic, with auxiliary tanks, or would be eminently suitable for services between Europe and Asia, where it could fly the Rome-Karachi stage non-stop. More recently, however, the Geneva office is also taking care of San Diego's many military interests. The F-102A and F-106A all-weather fighters have now been released for export to NATO countries, and Convair also has hopes of selling *Terrier* and *Tartar* missiles to Europe.

*

The visitor to a fourth-floor office in one of Geneva's many new buildings finds smiling at him from the wall the picture of a man who, though now of mature years, still makes a youthful impression—J. H. Kindelberger, Board Chairman of *North American Aviation Inc.* Alongside it is a picture of J. L. Atwood, the company's President.

These two men keep a fatherly eye on 38-year old *Robert J. Clark,* Director of European Operations for North American Aviation Inc., who opened the Geneva office early in 1957, after 15 years as project engineer in Los Angeles and later as liaison engineer in Washington.

Whereas the Geneva representatives of the U.S. companies so far listed came here principally for commercial reasons, Clark says that his job is mainly to supervise his company's sales and license agreements and to coordinate the work of the various technical advisory and sales teams in Europe. North American is concerned only with the military field and—besides deliveries to USAFE—has signed license agreements with Fiat, Spain's CASA and Rolls-Royce. A relatively new task is to sound out the market for the twin-jet T2J trainer and the UTX twin-jet communications aircraft, a kind of rival design to the Lockheed *JetStar.*

North American Aviation's Atomics International Division has been represented since August 1957 by Dr. Henri Polak in the neighbouring office.

*

The European office of *Fairchild Engine and Airplane Corporation* seems to lead a slightly quieter life. The office was opened in February 1956 under former USAF Colonel Leo W. Killen, who returned to the United States in the winter of 1957 and was replaced in Geneva by *Edward S. Bishop.* The office is responsible for technical matters in West and North Europe and for (possible) F-27 sales in Turkey, as well as for coordinating the work of the four Fairchild liaison engineers in Wiesbaden, Germany; Evreux/Draux and Chateauroux, France; and Pisa, Italy.

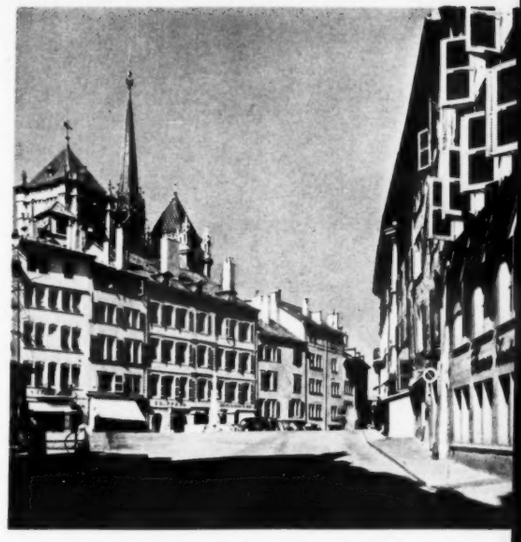
Bishop shares his office with *Malcolm B. Davis,* representative of the independent *Fairchild Aerial Surveys Inc.,* who spends most of his time travelling in connection with his company's many geological and other special survey contracts in Europe and Africa. The company also works for the U.S. Government and in conjunction with other governments.

Kenneth J. Luplow, Director of Boeing's European Office, and responsible for sales in Europe, Africa and Middle East.

George Cunningham Prill, Manager of Convair's European Office.

Robert J. Clark, Director of European Operations for North American.

Edward S. Bishop, Head of Fairchild's Geneva office.



*

The office is small and quiet, yet the visitor has the impression that business is good for the European representative of *AiResearch Manufacturing Co.* (The Garrett Corporation). *Bryan Sandford Clark* did not come to Geneva until late in 1957, when he took over sales promotion and sales of his company's entire production range. Important products for the European market include airborne air-conditioning systems, auxiliary power drives and auxiliary equipment for aircraft controls; the Air Data Computer, in particular, appears to have aroused considerable interest among European fighter manufacturers.

AiResearch's Geneva office already enjoys close contact with all the European airlines and, of course, with USAFE, all of whom use at least some AiResearch equipment. Many of Europe's newer aircraft designs, such as the *Caravelle,* the Saab 35 *Draken,* Fokker F.27, Fiat G.91 and even the Swiss FFA P-16, include Garrett equipment items.

At any rate Clark—not to be confused with his namesake at North American Aviation—is optimistic about his company's prospects in Europe. The continent's arms procurement plans and the rising interest in guided missiles fit exactly into Garrett's programme. The absence of a picture of this friendly Englishman, Bryan Sandford Clark, is due not to any deficiency on the part of our photographer, but to Clark's own natural modesty.

*

A total labour force of 282,000, sales topping $4,335,700,000 in 1957, three production divisions with a hundred sub-divisions...

such is *General Electric Company,* one of the world's biggest enterprises. The Aircraft Gas Turbine Division comprises five departments: Flight Propulsion Laboratory Department, Jet Engine Department, Production Engine Department, Aircraft Accessory Turbine Department, Small Aircraft Engine Department.

The Division's first European technical service office was set up in Paris, in the International General Electric building, in January 1956, but *R. E. Small,* Manager, European Technical Service Section, soon recommended a move to Geneva. In February 1957 he sent W. O. Meckley ahead to install the offices, joining him himself with his family later in the year. The Geneva organization was expanded in the spring of 1958, when engine specialist J. E. Gyarfas was sent to Switzerland. Today, this team is responsible solely for technical service, while sales are handled by the General Electric organization in Paris.

*

"Engineering Consultant Office Geneva" is the official title of the organization which the International Division of *Radio Corporation of America* has set up in this Swiss city. The office is headed by the Oslo-born *Marc J. Matsen,* now an American citizen in his early fifties and several times a grandfather. He is assisted by *August T. Tone,* as Factory Representative (Aviation), a man of around 40 who studied at the Massachusetts Institute of Technology and the University of Texas and has now set up home with his wife and two children in Versoix, near Geneva.

Other members of the permanent Geneva staff are J. D. Reid, responsible for civil RCA equipment, and John Riley, responsible for military equipment. It is naturally not possible in this small space to list all of RCA's navigation and communications equipment. Incidentally, the Geneva office also takes care of Gilfillan interests. The latter company already has a number of Quadradar installations in operation in Europe, and another ten are due for erection before the end of the year.

R. E. Small, Manager, European Technical Service Section, General Electric's Aircraft Gas Turbine Division.

Marc J. Matsen (seated), Head of Radio Corporation of America's Geneva office; August T. Tone, RCA's Factory Representative (Aviation).

Thomas D. Lockwood, Vice President and Director of Foreign Operations and Head of Montgomery's Geneva office.

Frédéric Chapuisat, President of AMF Overseas Inc.

*

But the big manufacturers are not the only companies to have opened sales or service organizations here. Nestling comfortably in the shadow of the giants is *Montgomery Equipment Co.,* of Van Nuys, California, whose local representative *Thomas D. Lockwood,* Vice-President and Director of Foreign Operations, opened the company's Geneva office last September.

Montgomery sells aircraft of all kinds, old, new or overhauled, and airborne and ground radio equipment, old, new or overhauled. Lockwood is 45, spends much of his time travelling, has branch offices in Paris and Madrid, and appears to have good business prospects, as the market for surplus flying equipment is only just opening up.

Hotel du Rhône, headquarters of the American Consulate General, Geneva.

*

Finally *American Machine and Foundry Company*'s organization has also branched out to Geneva with a subsidiary, AMF Overseas Inc. One of America's giants, AMF's production programme originally had little to do with the arms industry and nothing at all with the aviation industry. Of recent years, however, it has sold twelve swimming pool reactors to customers including Germany, Italy and Portugal. The Defense Products Group of the U.S. company supplies launching and ground equipment for the *Bomarc, Atlas, Titan, Talos* and *Goose* missiles in America, and one of its associated companies, Associated Missile Products Corporation, holds substantial contracts for missile electronics equipment.

President of AMF Overseas Inc. is *Frédéric Chapuisat,* an American citizen who has now returned to the city of his birth, following a career with the Swiss Bank Corporation in London and New York and a period of activity on behalf of Oerlikon Machine Tool Works, Bührle & Co.

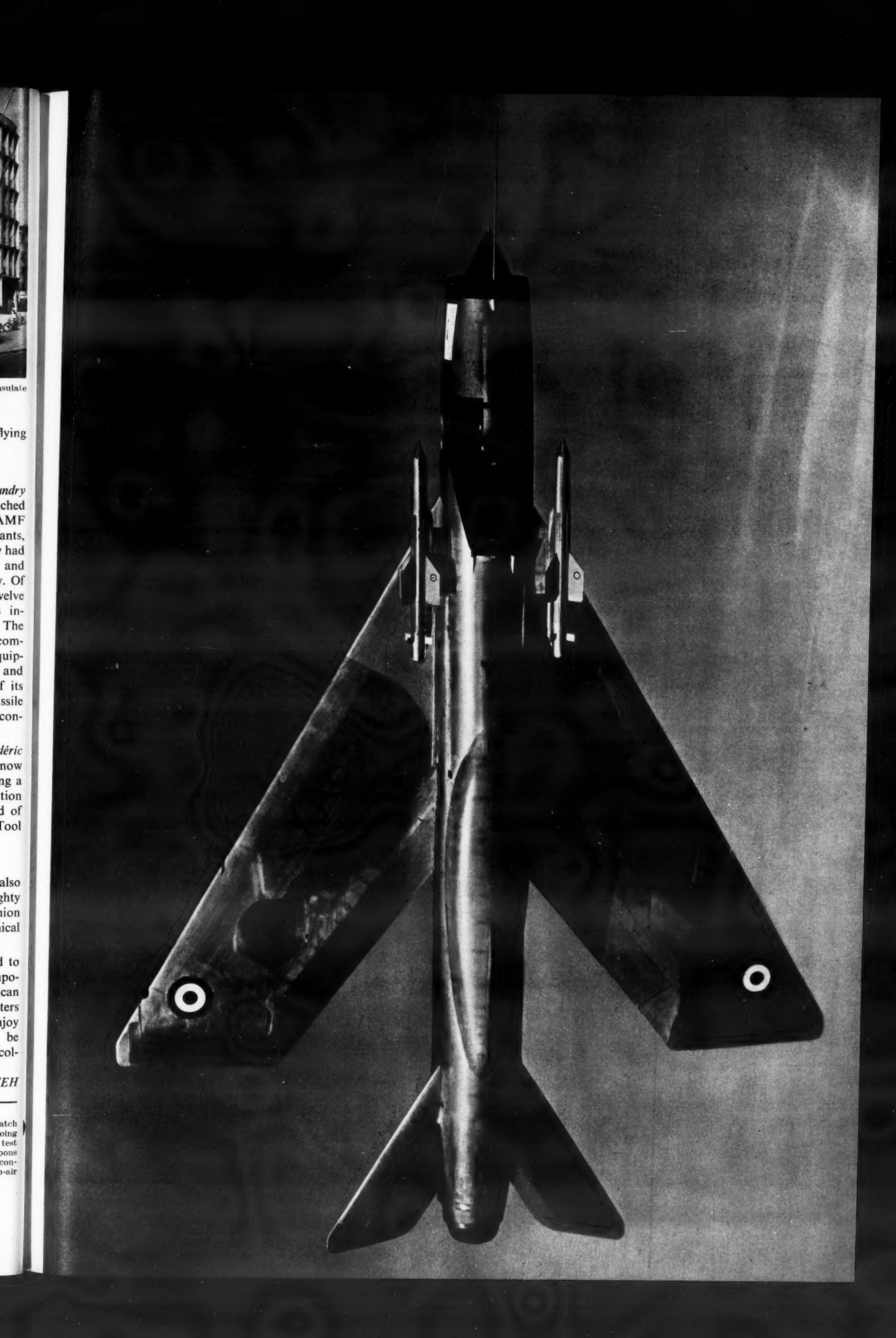
*

This is by no means all . . . Geneva is also the European headquarters of other mighty American concerns, of which only Union Carbide, one of the world's biggest chemical manufacturers, need be mentioned here.

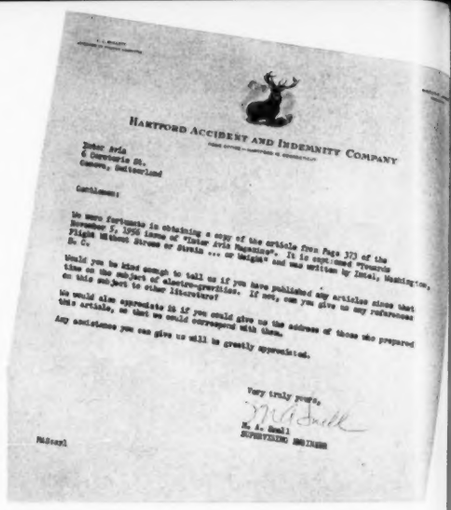
And we have been particularly pleased to see that, after 25 years, our two contemporaries, "Aviation Week" and "American Aviation", have discovered our headquarters and also set up offices in Geneva. We enjoy all fair competition, which can only be stimulating to us, and we welcome our colleagues to Europe's new aviation capital.

EEH

Flight testing of the prototypes and pre-production batch of the English Electric P.1B supersonic fighter is going ahead according to programme. Over one thousand test flights have been made, during which the entire weapons system has been tested, including the electronic fire control system and the de Havilland *Firestreak* air-to-air missiles shown here.



Editors on Thin Ice



HARTFORD ACCIDENT AND INDEMNITY COMPANY

Gentlemen:

We were fortunate in obtaining a copy of the article from Page 373 of the November 5, 1956 issue of "Inter Avia Magazine". It is captioned "Towards Flight Without Stress or Strain ... or Weight" and was written by Intel, Washington, D. C.

Would you be kind enough to tell us if you have published any articles since that time on the subject of electro-gravitics. If not, can you give us any references on this subject to other literature?

We would also appreciate it if you could give us the address of those who prepared this article, so that we could correspond with them.

Any assistance you can give us will be greatly appreciated.

Very truly yours,

M. A. Snell
SUPERVISING ENGINEER

The 326th reader's letter on electro-gravitics ... "this correspondance is now closed"

Letters which unfortunately did not go astray ...

If I were not already planning to fly to London tomorrow for two days, I would immediately sit down and write a stiff letter to Derek Wood, our London Editor, calling him over the coals. Not, you understand, that I don't appreciate both him and his work.

But on May 14th, 1958, at precisely 14:05 hours according to the entry stamp, we received the 326th letter on a subject which we had hoped was forgotten. It came from the *Hartford Accident and Indemnity Company, Hartford, Connecticut.* Mr. M. A. Snell, Supervising Engineer, wrote as follows:

"We were fortunate in obtaining a copy of the article from Page 373 of the No. 5, 1956 issue of 'Interavia Magazine'. It is captioned 'Towards Flight Without Stress or Strain ... or Weight' and was written by Intel, Washington, D.C.

"Would you be kind enough to tell us if you have published any articles since that time on the subject of electro-gravitics. If not, can you give us any references on this subject to other literature?

"We would also appreciate it if you could give us the address of those who prepared this article, so that we could correspond with them ..."

If we are not mistaken, it was in March 1956 that Derek Wood wrote that he had come across a man who would like to write about "weightless flight", a subject which was not then quite so much in the news as today. Wood did not know whether this man was an engineer, but he made an excellent impression and his references were O.K. There were two snags, however; as he was about to leave for the United States, he wished to be paid in dollars, and secondly he could not write under his own name, but must use the *nom-de-plume* of "Intel". The Editors thought—why not? and asked Wood to send the manuscript. When he read it through, Heinz Rieck, our Chief Technical Editor, wasn't altogether happy—he had never experienced weightlessness during his pilot days—but he took his courage in both hands ... and the article was published, albeit with reservations.

What followed surpassed all hopes, and certainly our Editors' ambitions. Half the world wrote to ask how they could immediately get in touch with "Intel"; weightlessness was a new subject for the layman, but a very serious subject for many a scientist. At any rate we immediately set about trying to locate "Intel" in America, but the man had completely disappeared into thin air ... leaving us on very thin ice. To make matters worse, he had included in his article a picture of an American "expert", Professor Townsend T. Brown, a very pleasant looking character, but also unlocatable. Soon we learned the kind of limb we had ventured out upon from some of the letters we received, a selection of which we published on Page 727 of *Interavia* No. 9, 1956. Readers in Düsseldorf, Paris and Pomona, California—not to mention quite a number of others—more or less called us to order.

Interavia clearly foresaw the technical feasibility of space travel as far back as the April 1949 issue (though the vehicle pictured admittedly dates from the 17th century).

Question to our readers: where and who is "Intel", where can we find Professor Townsend T. Brown... and what are we to reply to the 326th letter which Mr. Intel's efforts have brought us?

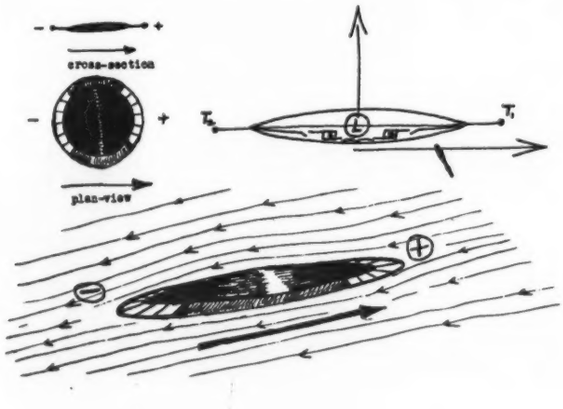
And Herr Weingard's address ?

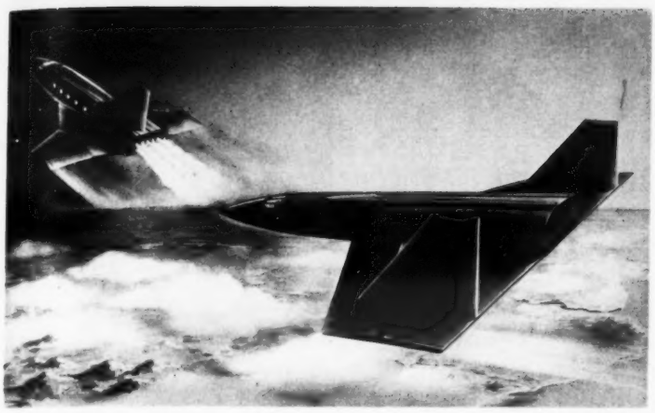
Actually, we should perhaps have known better; "Intel" was not the first *nom-de-plume* to have caused us embarrassment ...

In the early summer of 1954, when we were preparing issues Nos. 7 and 8 (July and August) on the subject of NATO and atomic armaments, we received a visit from a friend who has since become one of our regular contributors but at that time still occupied an official position. We thoroughly discussed the subject of the issues with him and wrote—largely following his suggestions—a warning article entitled "The Bomb—on Men and Cities", which really gave us a lot of work. The article expressed truths by which we still stand today, but a tricky question arose: Who should sign an article on such a highly political subject? To use our friend's signature was out of the question, but when we talked over the matter with him, he smilingly suggested we sign it "S. Weingard, Stuttgart" ... and brushed

This is how it began: a flying saucer as conceived by far-sighted "researchers" in 1908 and illustrated for posterity in *Interavia* No. 1, 1955.

Without stress or strain into space with "Intel" and Professor Townsend Brown. Right: Prof. Brown with his cuckoo's egg; left: space ship from "Intel's" workshop.





Winged passenger rockets, as predicted for the year 2000 by Walter R. Dornberger (*Interavia* No. 5, 1955).

The cover picture of this issue had a slightly sensational appearance, but its contents – including the article by S. Weingard, Stuttgart – were meant quite seriously. Although we have now revealed the secret of the *nom-de-plume*, at any rate in part, we still support what "Weingard" wrote.

aside our question as to who Herr Weingard was. We did not ask further . . . but our readers did.

The article made a hit, so did the name. The article was reprinted all over the world, Weingard became a famous man, and many people became interested in him. First the Americans, but even more so the Germans, who were particularly anxious to contact their far-sighted countryman.

At first we merely said that Weingard had gone abroad on a long trip, then he fell sick, and finally we quietly buried him . . .

Five pictures, five names

A nice mess our picture editors got us into through the "One plus Four" story which we published in connection with the 10th IATA Annual General Meeting in Paris.

Hosts for the Meeting were five French airlines, and on Page 760 of No. 11 (November 1954) we published pictures of the presidents of Air France, Air Algérie, Aigle Azur, TAI and UAT, who had worked hard to make the Meeting a success. The two editors whom we had sent to Paris came back with photographs of the five presidents, but forgot to mark the names on the back. Mathematically there are 120 possible combinations of five pictures and five names, but only one correct one . . . We need hardly say that we did *not* hit the correct one. A correction was published in the December issue of the same year.

*

The Russian enigma solved

We could have lifted the veil . . . About a year ago we were offered the whole truth about Russia . . .

The writer was an unknown German, who gave his address as "Café-Pension Zimmermann" in some half-hidden South German village. He wrote:

". . . I can supply you with regular first-hand information on interesting subjects, e.g., missiles: designation, development, development stage, main powerplant, launching aids, launching weight, thrust, diameter, span, range, ceiling, guidance system and other details . . . I should like to add that my information may not get into other hands than Western powers or companies (! Editors), including Switzerland."— He went even further and gave a list of all Russian missiles from T-1 to T-8, from ME to M-100A, in brief the whole alphabet. He offered nothing less than overnight fame.

Editorial guessing game: The following five names (in alphabetical order) belong to the five French airline heads pictured: Paul Bernard (TAI); Sylvain Floirat (Aigle Azur); Max Hymans (Air France); Jean Richard-Deshais (CGTA – Air Algérie); Louis Vidal (UAT). Like the picture editors of the November 1954 issue, readers can make 120 different combinations of photos and names, though only one combination is correct . . . A useful tip: watch the airline badges.

We thanked him politely but begged to be excused the honour.

Yet, believe it or not, a few weeks later we read our "correspondent's" revelations in an American trade journal which—unlike *Interavia*—always takes itself very seriously.

*

Nothing venture . . .

Just the same we have to admit that occasionally, during our 25 years history, we have tried to be serious.

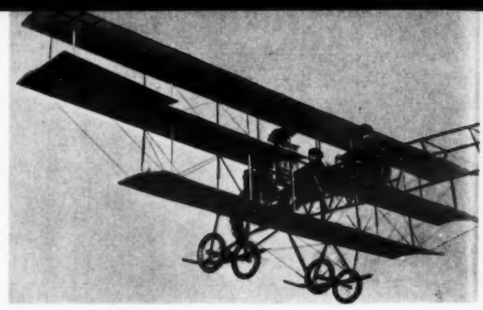
I still recall with satisfaction that, in an article entitled "Castles In and Beyond the Air" as far back as the April 1949 issue (pp. 187—190), our editor Erwin Herzfeld—though not an engineer, a man of wide interests—analysed the United States' earth satellite programme in a manner which still commands respect.

His appreciation was broadened seven years later, when we devoted the December 1956 issue to space travel under the title "Sun, Moon . . . and Stars". We still get a certain thrill of pride when we glance through the names of the authors who contributed to this issue: Engineer General G. A. Crocco (Italy), J. Kaplan (USA), S. F. (Fred) Singer (USA), Krafft A. Ehricke (USA), Professor J. Ackeret (Switzerland) and others.

And much of what they then wrote for us—things which still seemed improbable at that time and which even raised an ironical smile in some quarters—has now come true. In our modest way, we were also among the pioneers.

From time to time, reporters, journalists, editors *must* venture onto thin ice! There can be no timidity in the service of progress. *EEH*

The Russian enigma? We could have solved it . . . too bad!

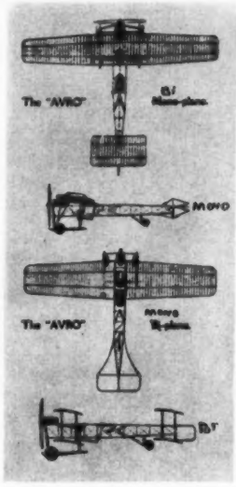


The Roe III triplane (with 35 h.p. Green engine) during a flight in 1910.

Monoplanes, Biplanes or Triplanes...

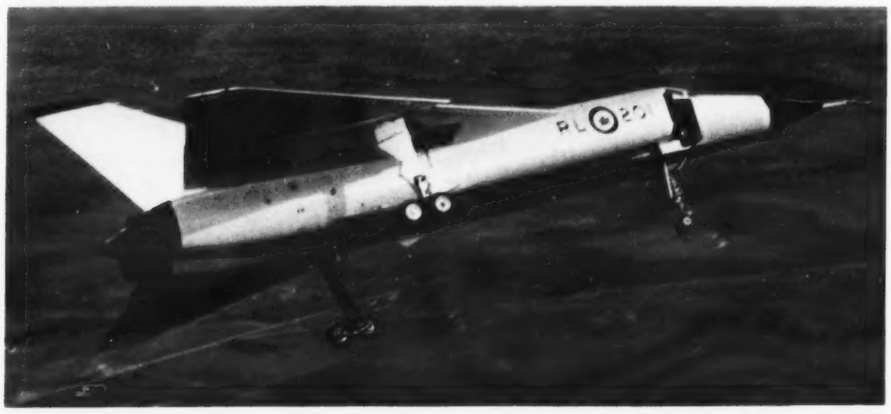
...Five Miles Flight Guaranteed

The first Avro aeroplane, Roe I, which (fitted with a 24 h.p. *Antoinette* engine) flew a distance of 75 ft. (2 ft. off the ground) at Brooklands, near London, on June 8th, 1908. Alliott Verdon Roe is standing in front of the propeller.



A. V. Roe & Co. supply everything: JAP engines, propellers, hangars and tents, consulting engineers and flying instructors, aeroplanes to clients' own designs, monoplanes, biplanes or triplanes from £450 . . . (Advertisement from "Flight" of January 1st, 1910). Right: Monoplane or biplane? The printers at any rate were by no means sure, and Alliott Verdon Roe had to correct one of his early pamphlets by hand ("The Aviator's Storehouse").

Today the monoplane reigns supreme: the Avro (Canada) CF-105 *Arrow* twin-jet supersonic long-range fighter.



On the 50th anniversary of the first British sustained flight

The publication of our Silver Jubilee issue coincides with a golden anniversary in British aviation history: on June 8th, 1908, 31-year-old marine engineer A. V. Roe (later Sir Alliott V. Roe), who had been experimenting with models for some years and had already made a number of glider flights, succeeded in making his first sustained powered flight. His earlier attempts had won for the enthusiastic pioneer only the nickname "Roe the Hopper". But this time the sceptical spectators were forced to admit that A. V. and his Roe I biplane (with 24 h.p. *Antoinette* engine) really could fly.

Before 1908 was out the successful designer and pilot had founded his first company, in partnership with J. A. Prestwich (designer of the JAP engines) and with a modest capital of £100. Two years later his brother joined him in founding A. V. Roe & Co. at Brownsfield Mills, near Manchester, a company which, among other activities, also ran a flying school at Brooklands.

As the half-page advertisement reproduced here from "Flight" of January 1st, 1910, reveals, A. V. Roe & Co. (Avro for short) had plenty to offer, particularly monoplanes, biplanes and triplanes with a guaranteed range of five miles. A few years later ranges had improved considerably, as in 1912 an Avro aeroplane won the British endurance record with a flight lasting 7½ hours, and on October 8th, 1914, the first aircraft bombs were dropped (by hand) on Cologne station from a number of Avro 504 military biplanes. Incidentally no fewer than 8,430 Avro 504s were built during World War I, about half of them by A. V. Roe & Co.

Between the wars Avro (which joined the Hawker-Siddeley Group in 1935) introduced some 35 aircraft types, including the famous twin-engine *Anson* (of which 11,020 were built). Its most important contribution to World War II was the *Lancaster* four-engine bomber, which made more than 150,000 sorties and was the mainstay of RAF Bomber Command. The years since 1945 have brought the *Tudor* airliner and *Ashton* research aircraft, the *Shackleton* four-engine anti-submarine aircraft, and the *Vulcan* four-jet V-bomber.

In December 1945 Avro purchased the former Victory plant at Malton, near Toronto, Ontario from the Canadian Government, founded A. V. Roe Canada Ltd. and brought out the successful CF-100 twin-jet all-weather fighter and the *Orenda* and *Iroquois* jet engines. Latest product of A. V. Roe Canada is the CF-105 *Arrow* supersonic long-range fighter which is to be powered by two *Iroquois* . . . and has a gross weight of over 65,000 lb.

Sir Alliott Verdon Roe died on January 4th, 1958, in his 81st year, and so just missed celebrating in person his golden anniversary as a pilot. But his life's work goes on in the British and Canadian undertakings which bear his name.

Today, as for many centuries past, coastal seaways and harbour approaches are areas that must be watched and defended.

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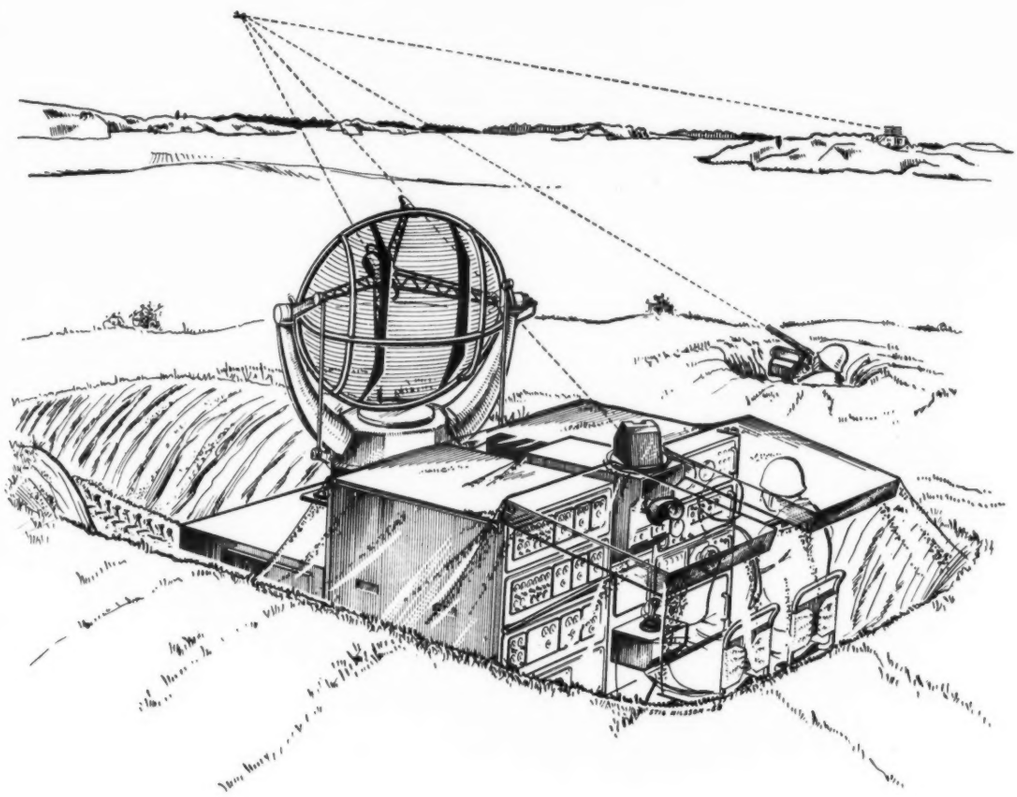

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In the field of navigation and weather instruments, Bendix has led the way for many years. The supreme skill and exacting craftsmanship employed in the design and manufacture of the Bendix line of ground station weather instruments are duplicated in the absolute dependability of Bendix airborne navigation instruments.

Many of the Bendix navigation and weather instruments are listed at the left. But remember —these are only two of the aviation fields in which Bendix excels. If you're in aviation, you'll want to know more about *all* the aviation products made by Bendix. For answers to specific questions, or just general information, contact Bendix International at the address below. Your query will receive immediate attention.

Bendix International

Division of Bendix Aviation Corporation, 205 E. 42nd St., New York 17, N. Y., U. S. A., Cable "Bendixint", N. Y.

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French engineers
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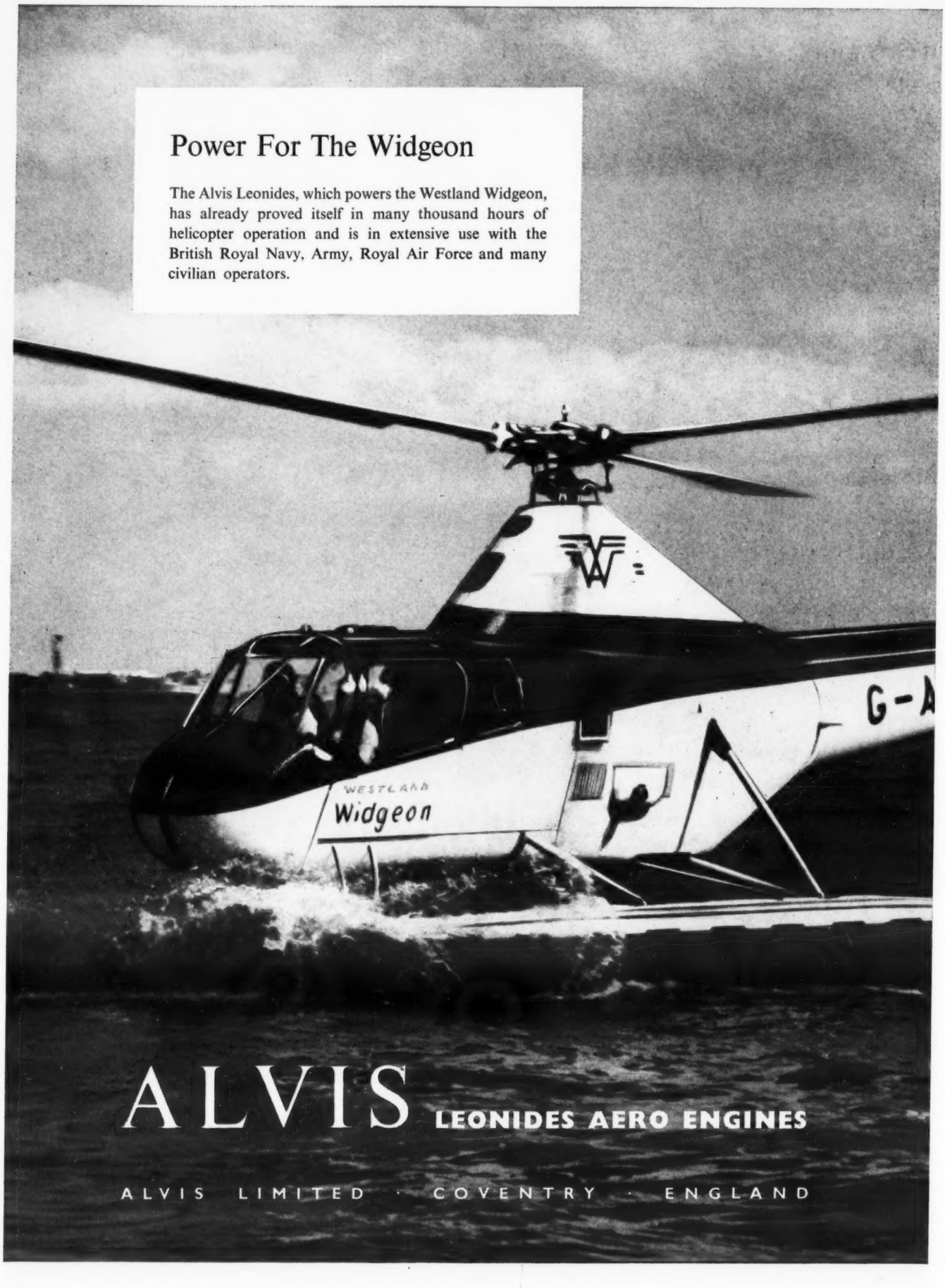
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The Alvis Leonides, which powers the Westland Widgeon, has already proved itself in many thousand hours of helicopter operation and is in extensive use with the British Royal Navy, Army, Royal Air Force and many civilian operators.
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Fairey Rotodyne

World's First VTOL Commercial Transport

Since November 6th, 1957, the day of its first flight, one of the most unusual aircraft ever built has been on view at White Waltham airfield, Berkshire, the *Fairey Rotodyne*. This combination helicopter, fixed-wing aircraft and autogyro designed to carry 40/48 passengers or an equivalent amount of cargo, will take off and land vertically, yet cruise across country at a speed of 160 knots.

By mid-April 1958 the *Rotodyne* had made roughly 70 test flights, including some with full transition from helicopter to autogyro... and back to helicopter operation. On one of these flights the *Rotodyne*—with Chief Test Pilot Ronald Gellatly at the controls, as usual—climbed to an altitude of 4,000 ft. as a pure helicopter, before converting to cruising flight.

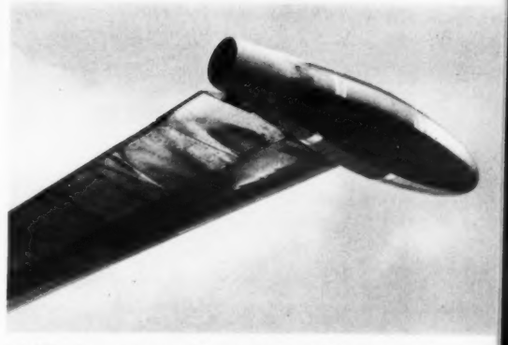
During cruise the aircraft—and this is one of the most important principles of its design—operates not entirely as a pure autogyro, but a substantial portion of its weight is supported by the air forces acting on the fixed wing. This is the reason for its relatively high cruising speed. As forward speed increases, the rotor is progressively unloaded; the blade pitch (and hence angles of attack) can therefore be reduced, thus avoiding break-away of the flow on the retreating blade and all harmful vibrations.

A visitor privileged to watch a test flight first sees the two Napier *Eland* turboprops being started up and then idling, with propellers feathered. Even when the engine rev. speed is progressively increased, the propellers still deliver little or no thrust. Instead two hydraulic clutches behind the propeller turbines proper take up the full torque of each engine and pass it on to the nine-stage auxiliary turbo compressors. The latter accelerate to full r.p.m., draw in air (up to 22 lb./sec) via a flush intake on the upper wing surface, compress it to 4½ times the ambient air pressure and then feed it via ducts to the rotor and its blade-tip pressure jets. At the same time a continuous flow of kerosene is injected into the jets, and the resulting air/fuel mixture is ignited with the aid of spark plugs. The rotor begins to turn and, after reaching its full power (defined by blade pitch and rotor rev. speed), lifts the aircraft vertically into the air, without forward run.

During take-off the pilot controls the *Rotodyne* in much the same way as a conventional helicopter: his left hand operates the collective pitch lever to control vertical climbing speed; his right hand the cyclic pitch stick to adjust the aircraft's pitch and roll, and hence forward or lateral movement. The pedals for yaw control act primarily on the pitch of the left and right v.p. propellers, and secondly on the aerodynamic control surfaces (though forward speed is still too low for them to produce any detectable effect). It should be noted that the rotor, which is operated by the blade-tip jets, does not produce any torque on the fuselage, so that no tail anti-torque rotor is required.

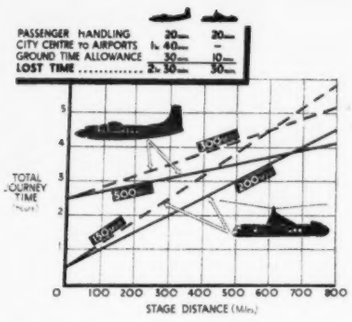
Once a given cruising or safety altitude has been reached, the pilot gradually transfers the full engine thrust to the two variable pitch traction propellers and at the same time cuts off the auxiliary compressors (supplying compressed air to the blade-tip jets) by means of the hydraulic clutches. Forward speed rises; the fixed wing provides increasing lift; the rotor autorotates and supplies the remainder of the lift required for level flight.

Before landing this process is reversed: engine power is gradually transferred from the two propellers to the auxiliary compressors; the blade-tip jets are ignited; speed is reduced; and landing takes place in a pure helicopter descent.

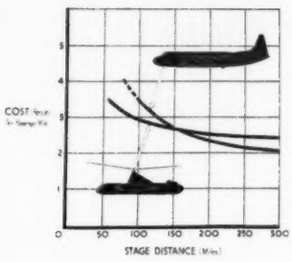


In the *Rotodyne* the secret of vertical take-off lies in the four blade-tip pressure jets, which rotate at 720 ft./sec and give the rotor a lifting force of roughly 18 tons.

The tip-jets, which work on compressed air and direct kerosene injection, were thoroughly tested in the experimental Fairey *Jet Gyrodyne* (upper picture) and the full-size test bed at Boscombe Down (lower picture).


PASSENGER HANDLING 20 min 20 min
CITY CENTRE to AIRPORTS 1h 40 min –
GROUND TIME ALLOWANCE 30 min 10 min
LOST TIME 2h 30 min 30 min
TOTAL JOURNEY TIME (Hours)
350
500
200
150
0 100 200 300 400 500 600 700 800
STAGE DISTANCE (Miles)

Up to stage distances of 400 or 600 statute miles the VTOL combination is superior to conventional airliners in total journey time, particularly in city-to-city traffic, as lost time is reduced by up to two hours.



In direct operating costs (in pence per passenger-mile) the *Rotodyne* also compares favourably with fixed-wing aircraft (e.g., the *Viscount*): up to a stage distance of 150 statute miles the *Rotodyne*'s operating costs are lower, over longer stages only slightly higher.

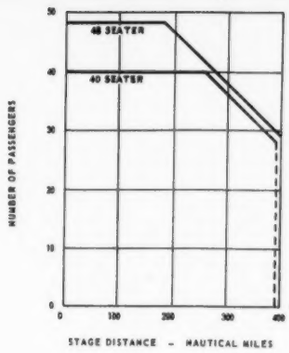
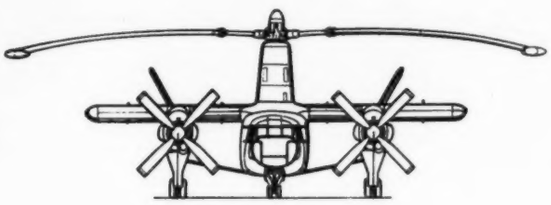
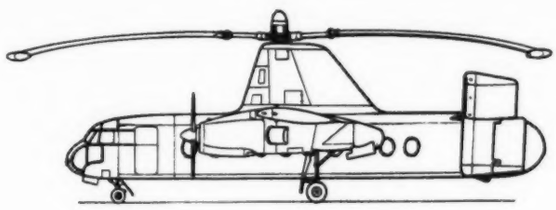
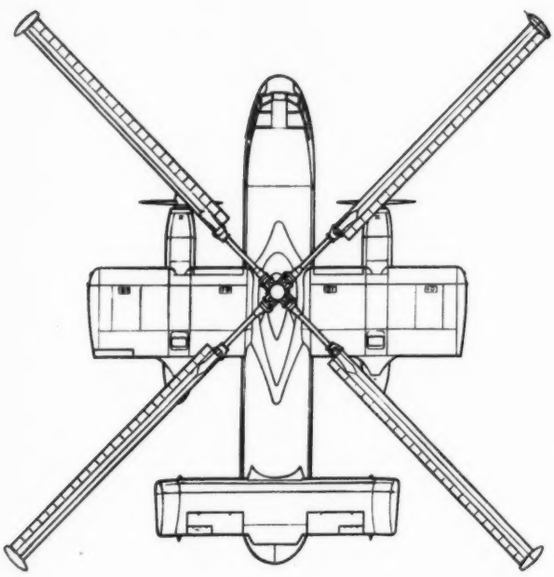


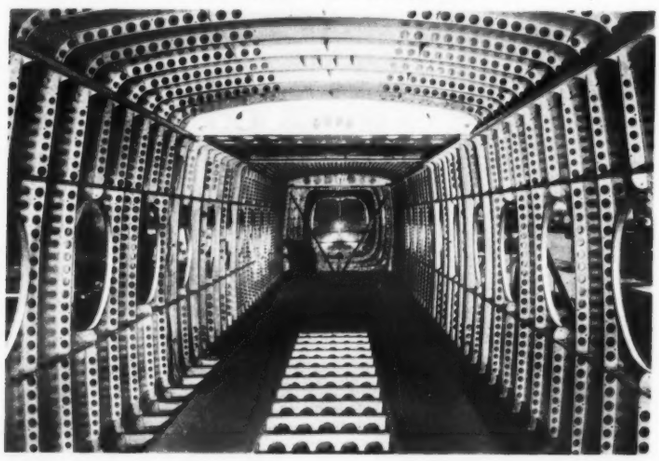
Diagram of passenger capacity plotted against block distance (in nautical miles). Allowance has been made for the following consumptions and reserves in addition to the normal fuel consumption for the journey: 3 minutes at maximum tip-jet power for take-off and landing; 20 minutes stacking with autorotation; 5 percent allowance on fuel carried.







The first prototype's roomy main cabin: width 8 ft., length 46 ft.



Technical Data

Dimensions

Rotor disc diameter	90 ft.
Rotor blade chord	27 ins.
Wing span	46 ft. 6 ins.
Fuselage length	59 ft. 8 ins.
Overall height	22 ft. 2 ins.
Cabin length	46 ft.
Cabin width	8 ft.
Internal cabin height	6 ft.
Height of cabin floor above ground	3 ft. 5 ins.
Rotor disc area	6,360 sq.ft.
Wing area	475 sq.ft.

Weights

Structural weight of 40-passenger version	7,039 lb.
Rotor (without blade-tip pressure jets)	5,312 lb.
Powerplant (with blade-tip pressure jets, fuel and air systems, gears, controls and hydraulics)	10,232 lb.
Safety equipment	279 lb.
Equipment and fixed installations	1,168 lb.
Removable fixtures (passenger seats, carpets, etc., toilet, passenger service equipment)	1,298 lb.
Operational load (two pilots, one steward, stage fuel and oil)*	6,273 lb.
40 passengers and baggage*	7,400 lb.
Gross weight	39,000 lb.
Rotor disc loading	6.14 lb./sq.ft.

Powerplant

NEI. 7 main engines at 12,500 r.p.m.	max. 2×3,500 e.h.p.
Compressor output with 4.5 : 1 compression ratio	approx. 2×22 lb./sec
Rotor tip speed on take-off	720 ft./sec

Performance

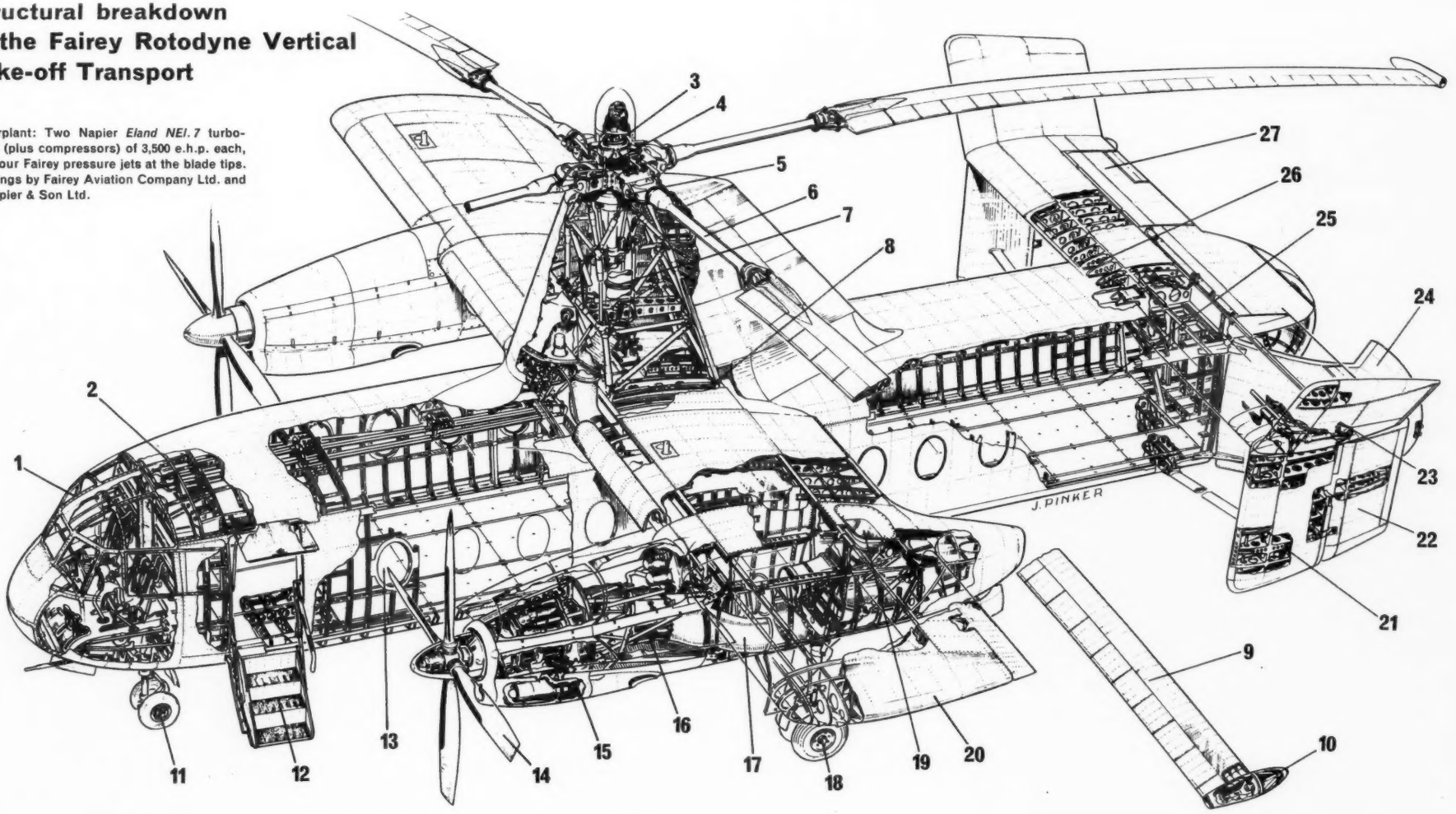
Cruising speed at 3,000 ft.	160 knots
Still-air range at 5,000 ft. (autorotation; 6,000 lb. fuel)	420 nautical miles
Sea level rate of climb, full load and ISA conditions	
— autorotation, two engines	2,000 ft./min
— helicopter flight, two engines, max. tip-jet power	1,580 ft./min
Hovering ceiling, two engines, max. tip-jet power, without ground effect, ISA conditions	
— full load	6,600 ft.
— with 35,000 lb. gross weight	10,500 ft.
Service ceiling (rate of climb 150 ft./min) on one engine, in autorotation, with increased continuous power, ISA conditions	3,300 ft.

* Maximum fuel capacity 7,500 lb.

Structural breakdown

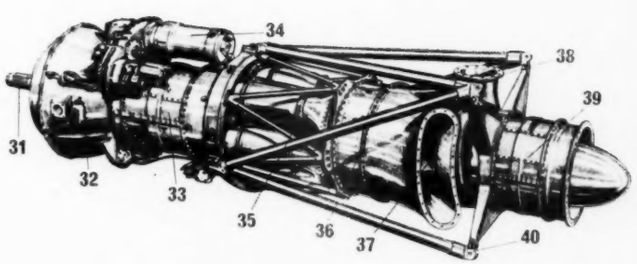
Structural breakdown of the Fairey Rotodyne Vertical Take-off Transport

Powerplant: Two Napier *Eland NEI. 7* turboprops (plus compressors) of 3,500 e.h.p. each, plus four Fairey pressure jets at the blade tips. Drawings by Fairey Aviation Company Ltd. and D. Napier & Son Ltd.



Key

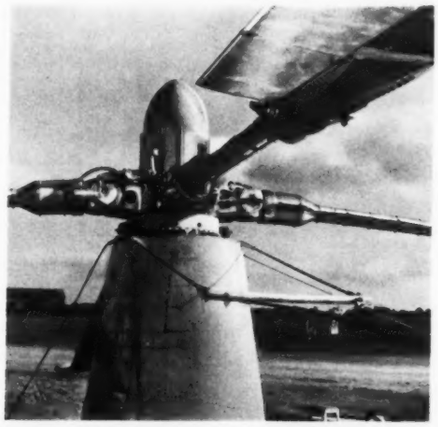
1 Cabin for two pilots (with dual controls)
2 Rotor and powerplant controls
3 Swashplate (with 4 spider arms) for collective and cyclic pitch change
4 Rotor hub (with 4 stub arms) and main bearing
5 Flapping hinge (with air seals)
6 Blade spar tube forming duct for compressed air, with attached fuel and ignition lines
7 Coaxial main air trunks
8 Pylon
9 Two-spar rotor blade, with three air ducts
10 Fairey tangential pressure jet
11 Retractable dual nose wheel
12 Door and fold-up stair
13 Forty-passenger cabin (two windows per seat row)
14 Rotol variable pitch propeller
15 Oil cooler
16 *Eland NEI. 7* turboprop-plus-compressor
17 Bifurcated engine exhaust
18 Retractable twin wheel
19 Air entry to auxiliary turbo-compressor (for tip-jets)
20 Wing (and fuel bag tanks)
21 Lower (fixed) fin
22 Rudder (with hydraulic jack)
23 Upper (hydraulically foldable) fin
24 Clam-shell freight door (hydraulically operated)
25 Rear part of main cabin, earmarked for toilet and suitcase stowage (passenger version) or to be used as freight hold (passenger-cum-freight version)
26 Tailplane
27 Electrically operated elevator



31 Propeller shaft
32 Reduction gear
33 Ten-stage main compressor
34 Auxiliaries (generator and hydraulic pump)
35 Six combustion chambers
36 Turbine casing (for 3-stage turbine)
37 Bifurcated jet pipes and (between them) hydraulic clutch to auxiliary compressor
38 Outlet for compressed air
39 Nine-stage auxiliary compressor
40 Engine mount

The *Rotodyne's* controls and instruments: note the control columns (in front of each seat) for cyclic pitch change to control the aircraft in pitch and roll, also the levers (to the left of each seat) for collective pitch control. The pedals are used both to vary the propeller pitch of the two engines and to control the rudder. Finally the two throttle levers control engine power during autorotation. The instrument panel carries the usual VFR, IFR and navigation instruments, plus a number of dials for engine data.

Starboard engine in the *Rotodyne*... with its mighty Rotol four-blade variable pitch propeller (diameter 13 ft.) and outboard fork of the bifurcated exhaust pipe.



The four-blade rotor rotates freely on its bearing: during take-off and landing it is driven by the blade-tip jets, during cruise by the air stream.

Test running the turboprops: hydraulic clutches in front of the auxiliary compressors set the rotor in motion (by passing compressed air to the blade tips). The undercarriage will be retractable in the production version.

It should here be mentioned that the *Rotodyne* of course remains fully capable of flight and of landing even should one engine fail, and can continue to operate at altitudes of more than 3,000 ft. During cruise with autorotation the asymmetrical propeller thrust can be compensated with the aid of the rudder unit; during the landing approach only one pair of rotor blades (diametrically opposite blades) is supplied with compressed air by the auxiliary compressor of the good engine, and this is sufficient for fine control of the rate of descent before touchdown. In an emergency a normal autorotation landing can also be made—though this should if possible be limited to full-size airports because of the run-out distance required.

Thus the *Rotodyne* has all the advantages of a multi-engine fixed-wing aircraft which are denied the helicopter, in particular good cruising speed, economic payload, absence of vibrations, ability to operate on one engine, full night and all-weather flying capability . . . and it is equipped to take off and land vertically.

Design and development of this VTOL transport are attributable to a team of Fairey engineers under the leadership of the company's Technical Director, R. L. Lickley, B.Sc. Under him, Dr. George S. Hislop, the Chief Designer, was in charge of design, and F. Parker (Engineering Manager) in charge of manufacture. It took no less than 3½ years, from receipt of the first workshop drawings, to build the prototype now being flight tested. A glance at the structural drawing of the *Rotodyne*—incidentally highly simplified—will readily explain this. In addition it should be realized that the 35-ft. U-section forward spars for the rotor blades are of air-hardened steel, and that some of the steel forgings for the rotor head weigh as much as 14 cwt. (1,568 lb.). Many parts, such as the rotor blade leading edges and the compressed air ducts, had to be made of stainless steel, and heat-resistant Nimonic alloys were chosen for the blade-tip pressure jets.

Hand in hand with construction of the airframe, the normal *Eland* turboprop was converted into a turboprop-plus-compressor engine at *D. Napier & Son* . . . a company which this year is celebrating its 150th anniversary in general machine building, automobile engines and aircraft engines. Napier developed the nine-stage auxiliary compressor for the engine and the hydraulic clutch between the two, also carrying out the necessary modifications to the turbine shaft and the exhaust pipe. Thanks to space and weight saving design, the engine's overall length was increased by only some 46 inches (to 166 inches), and its weight by roughly 800 lb. (to 2,400 lb.).

The second *Rotodyne* prototype is scheduled to begin flight testing at the end of the year, and a large number of parts for the subsequent production models are already being manufactured.

Early Navigation Aids—An Eye-Witness Account

By Wolfgang von Gronau, Frankfurt/Main

When I was serving with the German naval air service as a young sublieutenant in 1915, we were still navigating by purely nautical methods. We estimated wind force and direction from the state of the sea—if necessary in low-level flight—read off speed and heading from our aircraft instruments and composed our wind triangles. Very soon, however, we learned to ascertain drift a little more accurately with the aid of a bomb sight and stop watch, and by the end of 1916 many naval aircraft were also equipped with radio and could obtain bearings from directional receivers on the mainland.

These first attempts at air navigation at sea were further encouraged in Germany during the twenties, in particular by the BSX Section of the Navy (under *Captain Lahs)*, the Deutsche Lufthansa *(Dr. Stüssel* and *Captain Schiller)* and the WGL and DVL Navigation Committee under *Dr. Koppe*. Finally, mention should also be made of the List Seaplane School, Sylt, a section of the German Commercial Flying School (DVS), which was headed by myself assisted by Herr *Niemann* and Herr *Klintzsch*.

Early in the twenties, too, *Admiral Coutinho,* of Portugal, introduced celestial navigation into aviation. On his South Atlantic flight (with *Cabral)* in 1922 he used a new type of sextant with two spirit levels at right angles, an instrument which could also be used for observing the visible sea horizon. As he had good weather, Coutinho did not rely on his spirit levels, but preferred to use the visible horizon. For every shooting of a heavenly body, he went down close to the water to obtain a more accurate horizon line and eliminate the effect of altitude (not always known accurately) and hence of the dip of the horizon. By these means he picked up minute St. Paul's Rock in the middle of the Ocean, where he was to refuel.

Spirit level sextants worked reasonably well during stable flight, but were sensitive to accelerations. Various other devices were therefore tried out to provide sextants with a horizon, in particular pendulums and gyro horizons, and finally the instrument was mounted in the cabin roof. But then it was inevitably subjected to all of the aircraft's accelerations, whereas previously the observer had been able to persuade himself that he "absorbed" at least some of these motions. Nevertheless, measuring errors could be reduced by making a series of observations and taking the mean value. Next a wide variety of tables, nomograms and computers were devised to speed up evaluation of measurements. Also crews planning longer flights worked out a number of altitude curves (e. g., for the sun and moon) in advance, on the basis of the flight plan and plotted against time; they could then tell after every measurement and a brief glance at the altitude curves whether they were exactly on course or by how much they had deviated. The choice of system was a matter of either personal preference or experience.

In 1925 Spain's *Franco* flew to the island of Fernando Noronha, off the Brazilian coast, in a Dornier *Wal* which he had equipped with a primitive D/F receiver. This marked one of the early successes of radio navigation.

For determining heading, crews of those days had to rely mainly on the magnetic compass, which was far from satisfactory. Iron parts of the aircraft generally caused such serious deviations that the location of the compass had to be very carefully chosen and was not always in direct sight of the pilot. In rough weather the compass's northerly turning error made it difficult to hold a given heading, particularly on northerly courses. Finally, it must be remembered that at sea the pilot rarely encounters landmarks and that the horizon is also often hazy. In such cases all he could do was stare at the compass rose the whole time. My "*Amerika-Wal*" was therefore fitted with a large master compass (in the navigator's post), two pilot compasses (for blind flying), an observer's compass (for visual flight), an earth induction compass and a sun compass. I gladly accepted the extra weight of all this equipment, as it helped tremendously to save fuel by enabling me to keep on course. But I could not afford the weight of a gyro compass such as the Zeppelin airships were using at the time, and directional gyros were still under development.

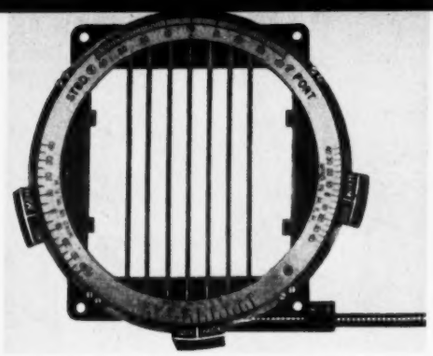
In view of all these difficulties, it is understandable that a cry for an automatic pilot soon became heard. At the end of World War I *Franz Drexler* was working on an instrument of this kind at Berlin-Adlershof, in 1926 *Boykow* exhibited a three-axis autopilot at the Berlin ILA Show, and in 1930 a (much simpler) directional autopilot by Askania was demonstrated. One pilot said at the time, after trying out the Askania equipment, that crews would "no longer need legs" in future. Unfortunately not all pilots unreservedly welcomed the new development, as they feared that their high degree of training and skill would lose its value. The introduction of the autopilot took place only very gradually and went hand in hand with the professional advancement of the "pilot" into the "aircraft captain".

The development of blind flying instruments was also slow. Towards the end of the twenties a German firm brought out the first artificial horizon, known as the "Gyrorektor", which I fitted in my "*Amerika-Wal*" for my first flight from List to New York (1930). The equipment worked well enough, but was heavy and bulky, and required a very large generator which was driven, as was the *Wal's* much smaller radio generator, by a propeller in the air stream. The improved "*Grönland-Wal*", in which I flew across southern Greenland (from Scoresbysund to Sukkertoppen and Godthaab) and on to Chicago a year later, was equipped with a Sperry artificial horizon, which was only one tenth as heavy and as bulky as the *Gyrorektor*.

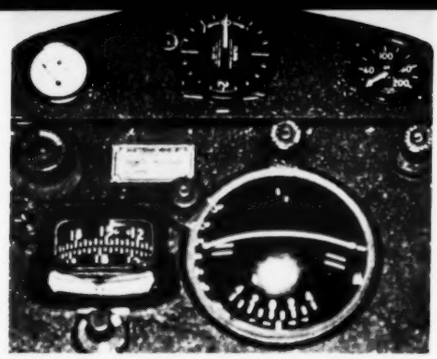
A word here on drift measurement. This is a relatively simple process over land, but at sea it raises certain problems. As observation of the

August 26th, 1930: Alighting in the Port of New York; in the rear the Battery and the skyscrapers of South Manhattan.

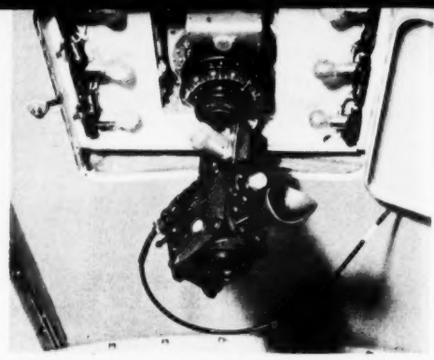
The List Seaplane School, Sylt, part of the old Deutsche Verkehrsfliegerschule (German Commercial Flying School).



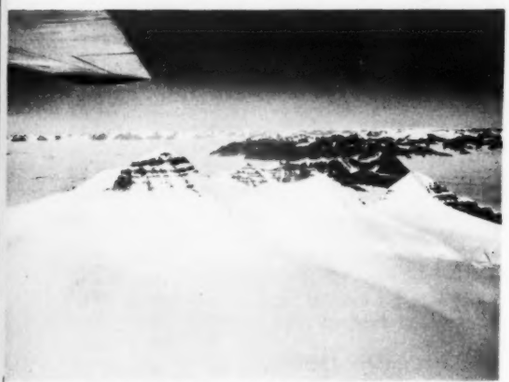
Drift sight (for installation in the fuselage floor), complete with remote control cable for the grid ring.



Sperry directional gyro (left) and artificial horizon (right) in the cockpit of Wiley Post's Lockheed *Vega* "Winnie Mae".



A modern astro compass, with polarization analyser for indirect sunlight, fitted in the cabin roof of an Air France Lockheed *Super Starliner*.



August 15th, 1931: Flying over Greenland's ice deserts, the author discovered a hitherto unknown mountain, the Gronau Nunataker.

The "Grönland-Wal" in a fjord on the west coast of Greenland.

October 10th, 1932: The *Wal* being towed into harbour by a British steamer after an emergency alighting in the Indian Ocean; in the foreground a D/F loop.

November 4th, 1932: Marshal Balbo welcoming the author and his crew at Ostia Seaplane Station after their return from their round-the-world flight.

wave caps often did not provide a satisfactory reference, it was sometimes the custom to drop dye bombs and observe them by means of the drift sight. Among the various types of drift sight, the variety which was fitted in the fuselage (floor drift sight) usually worked satisfactorily, whereas the sights which projected sideways from the fuselage walls were not very reliable. All these instruments, of course, could be used only when the ground was visible. Despite a number of attempts to utilize the lines of force of the earth's magnetic field, the problem of measuring drift above the clouds has not been solved until quite recently. Only the introduction of Doppler radar will lead to a real improvement, though meanwhile some assistance in determining angle of drift can be obtained from the airborne weather radar.

The altimeter, which is of paramount importance in correcting bearings taken on heavenly bodies and in instrument landings, has been constantly improved through the years. Both coarse and fine altimeters which are practically frictionless and hence quick to respond were designed, but all depended for their accuracy on precise knowledge of the sea level air pressure at any given moment. Some progress was made with the echo depth sounder introduced in shipping by *Behm* and adapted for aviation use. The main feature of this equipment was a very rapid sequence of detonations during landing approach; however, the sonic altimeter was never widely used because it was heavy and complicated to handle. Even in those days the highest hopes were placed in an electrical echo sounder such as is virtually standard equipment today in the majority of commercial and military aircraft, in the form of the radio altimeter.

Early attention was also paid to meteorological air navigation—pressure pattern flying—such as the Zeppelins used to detour round bad weather areas and avoid strong head winds. Here, of course, we were dependent on the extent of the meteorological services along the routes flown and on the technical qualities of our radio equipment. Experiments were even made to find a facsimile receiver for weather maps, which would be small enough and light enough to install in aircraft.

Meanwhile the conviction was growing that the majority of problems could be satisfactorily solved only with the aid of radio navigation. After simple homing receivers with fixed antennas and rotating coils, more elaborate airborne D/F equipment with loop aerials provided the first assistance. Their performance was so good that they enabled small islands or ships at sea to be located without difficulty. However, they were very heavy and could therefore be used only in large aircraft. This equipment, which had also been taken over from marine navigation, naturally had to undergo a large number of modifications before it was ready for air navigation use. During the same period a network of ground D/F stations was being built up to give aircraft, on request, their position or homing course. At first the twilight effect was a serious handicap, but this was later overcome by the use of Adcock antennas and other methods. This form of direction finding necessitated good radio communications with the ground stations, which led to the development of increasingly efficient multichannel airborne radio equipment, initially for W/T communications. There were even efforts made to use VHF in air-to-ground traffic.

By the end of the twenties the USA had already gained a considerable lead over European development. For example, my friend Jimmy Doolittle made the first complete instrument flight, including instrument take-off and instrument landing, in a small experimental aircraft in 1929, and the well-known solo pilot Wiley Post was able to leave control of his Lockheed *Vega* monoplane, the "Winnie Mae", almost entirely to a Sperry autopilot during his second round-the-world flight (1933). The accessory firms in the United States received a far greater impetus than in Europe because of the larger number of aircraft built in that country.

In conclusion I should like to summarize my own experience with early navigation aids:

1930: Flight from List via the Faroes, Reykjavik, Ivigtut (southern Greenland), Cartwright (Labrador), Queens Port and Halifax to New York City and Chicago in an elderly Dornier *Wal* flying boat (acquired from Roald Amundsen). Because the aircraft was unstable and the control surfaces so difficult to operate, it took two men for blind flying; the first pilot operated the rudder and ailerons, the second the elevators. Between Iceland and Greenland height of cloud was 300 to 600 ft., visibility was about 6,000 ft. and there was a north wind of 25 to 35 knots. We flew at altitudes of 150 to 300 ft., below the clouds, so as to be able to measure drift; there were no radio stations from which we could have obtained D/F bearings, and the magnetic variation on this route increased from —20° to —40°. Nevertheless we located Ivigtut at our first attempt. Between Greenland and Labrador the radio generator failed, but we were able to keep the equipment going with the aid of a standby generator driven by a gasoline motor. We flew above the clouds, and two solar position lines taken indicated strong tail wind. Later we made a blind alighting off Halifax in the fog by carefully feeling our way down to the water surface.

1931: Flight from List via Reykjavik, Scoresbysund (eastern Greenland), Sukkertoppen and Godthaab to Hudson Bay, Chicago and New York City in an improved *Wal* more suitable for instrument flying. From Iceland to Scoresbysund we flew on our D/F equipment. Above Greenland's ice wastes radio communications broke down and could not be resumed until 120 miles from the west coast of Greenland. Even then the D/F minimum wandered as much as 90°. On the Greenland-Hudson Bay stage the sun compass was used because of the proximity of the magnetic pole.

1932: Round-the-world flight List–List, via Iceland, southern Greenland, Canada, the Aleutians, Japan, Indonesia and along the coasts of the Indian Ocean, in the same *Wal*. The aircraft was fitted with communication equipment for MF and HF, as well as a D/F receiver and an emergency transmitter, and we navigated throughout the flight by landmarks and D/F without difficulty.

Spotlighting the World's Oldest Air Route

PARIS-LONDON

1933 . . . Let's go to London!

"His Excellency M. de Fleuriau, French Ambassador in London, is a well-known figure to the Company. His first journey by air only dates from eighteen month ago, but almost each week he crosses from England to France or vice versa..."

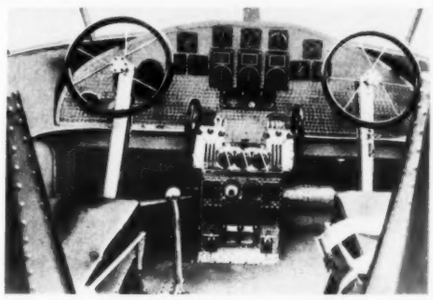
Today, in the age of regular Arctic services to the United States and Japan, such air-mindedness would scarcely arouse interest. But 25 years ago it was considered so impressive an advertisement for the company that the French airline *Air Union* devoted half a page of its monthly bulletin to the "Flying Ambassador", with a picture showing Monsieur and Madame Fleuriau shaking hands with the Air Union manager before climbing aboard the aircraft for London.

In those days the Channel service between France and England was the French airlines' showpiece. The world's first international passenger air service, the Le Bourget (Paris)—Croydon (London) route had been opened early in February 1919, and by 1933 was being operated three times a day in summer and twice a day in winter, by three-engine Wibault 282 *Golden Clippers*. Operators were Lignes Farman and Louis Breguet's Air Union, both of which companies were merged into Air France in 1933.

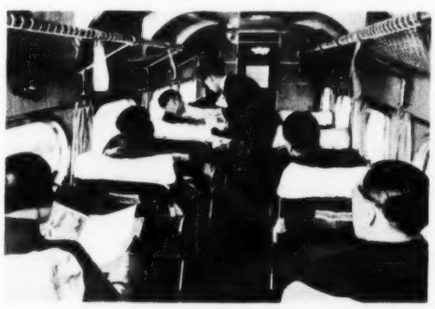
"The Golden Clipper", says a 1933 brochure, "takes you from Paris to London in 100 minutes, 35 minutes less than other aircraft. As only 10 passengers are carried, en-route service is impeccable... and an unequalled degree of comfort is provided: large hermetically sealed windows exclude all draught but admit full light... specially designed lighting permits reading at night..."

Today Air France flies the Paris–London route ten times a day in both directions. The three-engine Wibaults have been replaced by Vickers *Viscounts* with four propeller turbines. France's airlines carried 14,765 passengers on the route in 1933; by 1957 Air France had increased this figure to 230,981. Twenty-five years ago His Excellency the Ambassador had to pay 900 French francs (then worth $ 55.30) for the round trip. Today fares are 23,400 francs ($ 55.70) return by luxury class "Epicurien" and 19,250 francs ($ 45.80) return by tourist class.

The 60-minute flight across the Channel is no longer the showpiece of Air France's network—the longest in the world, with 180,000 unduplicated route miles—but it still represents an important tradition in French air transportation.



The Wibault 282's innocent-looking instrument panel.



An unequalled degree of comfort was provided for this luxury airliner's 10 passengers . . . The lady on the left is not wearing a crash helmet but the latest thing in Paris hats.

An Air Union three-engine Wibault 282 awaiting its passengers for London in front of the old control tower at Le Bourget.

Air France passengers for London are invited to proceed to their Vickers *Viscount*.

New Lufthansa—the First Three Years

By Dipl.-Ing. Gerhard Höltje,
Board Member of the Deutsche Lufthansa AG
Cologne

May 15th, 1958, saw the third anniversary of the day on which the reborn Deutsche Lufthansa AG opened scheduled services between Western Germany and the European capitals, and once again took her place in the ranks of the world's civil carriers. Since that day in 1955 Lufthansa has made striking progress and her fleet now comprises 12 long-range Lockheed 1649G *Super Stars* and 1049G *Super Constellations,* with 9 medium-haul Convair *Metropolitans* and 3 short-haul DC-3s. In the autumn of this year delivery of 9 medium-haul Vickers *Viscount 810Ds* will begin, and on order from the United States are 4 Boeing 707 *Intercontinental* jet transports scheduled for delivery in 1960. Alongside this fleet of transports Lufthansa's Flying School in Bremen has an additional 15 training aircraft, *Twin Bonanzas,* Saab *Safirs* and de Havilland *Chipmunks,* which are entirely devoted to the schooling of a new generation of up and coming pilots.

Lufthansa's current route network covers some 48,000 miles, and is serving a total of 34 cities in 23 different countries spread over 5 continents. During the peak period of the summer touring season the West German flag carrier offers 12 weekly North Atlantic flights in each direction to link Hamburg, Düsseldorf, Frankfurt, Brussels, Paris and Shannon with New York, Montreal and Chicago. To and from South America the carrier flies three weekly services in each direction, including one service to Santiago de Chile. To the Middle East four services weekly are operated.

The company's operating statistics for the past three years give an indication of the great strides already made:

	1955	1956	1957
Passengers:			
First Class	1,870	9,197	17,095
Tourist Class	72,200	220,473	412,770
Total:	74,070	229,670	429,865
Freight (in tonnes)	550	1,990	3,332
Mail (in tonnes)	363	1,050	1,546
Passenger load factor	43.0 %	52.0 %	57.2 %
Overall load factor	35.9 %	46.0 %	53.1 %
Production, in millions of tonne/kilometers	25.3	76 *	105.6 *

* including charter work

These figures point to a traffic increase which is without parallel even in the booming post-war development of overall world air traffic. The problems confronting the new company in these early years have still not all been solved. Nevertheless it is clear that today the new Lufthansa has emerged from a period of adolescence and is now ready to carry on the great tradition which the company has inherited from its earlier namesake and predecessor. The rapid growth of the company is due in no small way to the international goodwill which has been extended to Lufthansa on her re-entry into the international scene; the world's airlines have given every possible encouragement to the young newcomer and several airlines have given particularly valuable direct assistance by the loan of Flight Captains for fixed periods.

On the basis of the development to date, Lufthansa is looking forward to the future with great optimism. The German carrier's share of world air traffic today stands at a modest 0.6 percent, but the West German Republic's share of world trade runs at 7.5 %. The policy of Lufthansa's management is to narrow this gap and to win a more realistic share of the world's traffic for their new undertaking.

In building up its route network Lufthansa has been influenced by two considerations. On grounds of economic operation the development of long-stage routes has been given preference over the medium and short-stage hauls; and secondly the company has sought to develop intercontinental routes to those areas where the German export industry is most active. In this planning the North Atlantic tourist business was borne in mind as a most important factor in foreign trade. With the entry into service of the additional medium-range transports now on order, Lufthansa plans very shortly to fill the gaps in her existing domestic and European network, and to improve services to the Near and Middle East.

Conforming with IATA decisions, Lufthansa is operating all four classes of passenger traffic on her aircraft (Economy, Tourist, First Class and De Luxe). Only time will tell if the system of offering more than two classes of travel in the same aircraft is satisfactory.

Lufthansa hopes that the present degree of international cooperation in the field of civil air transport will not only be maintained, but will be broadened. The company firmly believes that all the civil carriers will benefit from a far-reaching coordination of their interests.

Dr. Kurt Weigelt (born 1884), Board Chairman.

Hans M. Bongers (born 1898), Commercial Director.

Dipl.-Ing. Gerhard Höltje (born 1907), Technical Director.

Captain Rudolf Mayr (born 1910), Chief Pilot.

Branchliner Supreme

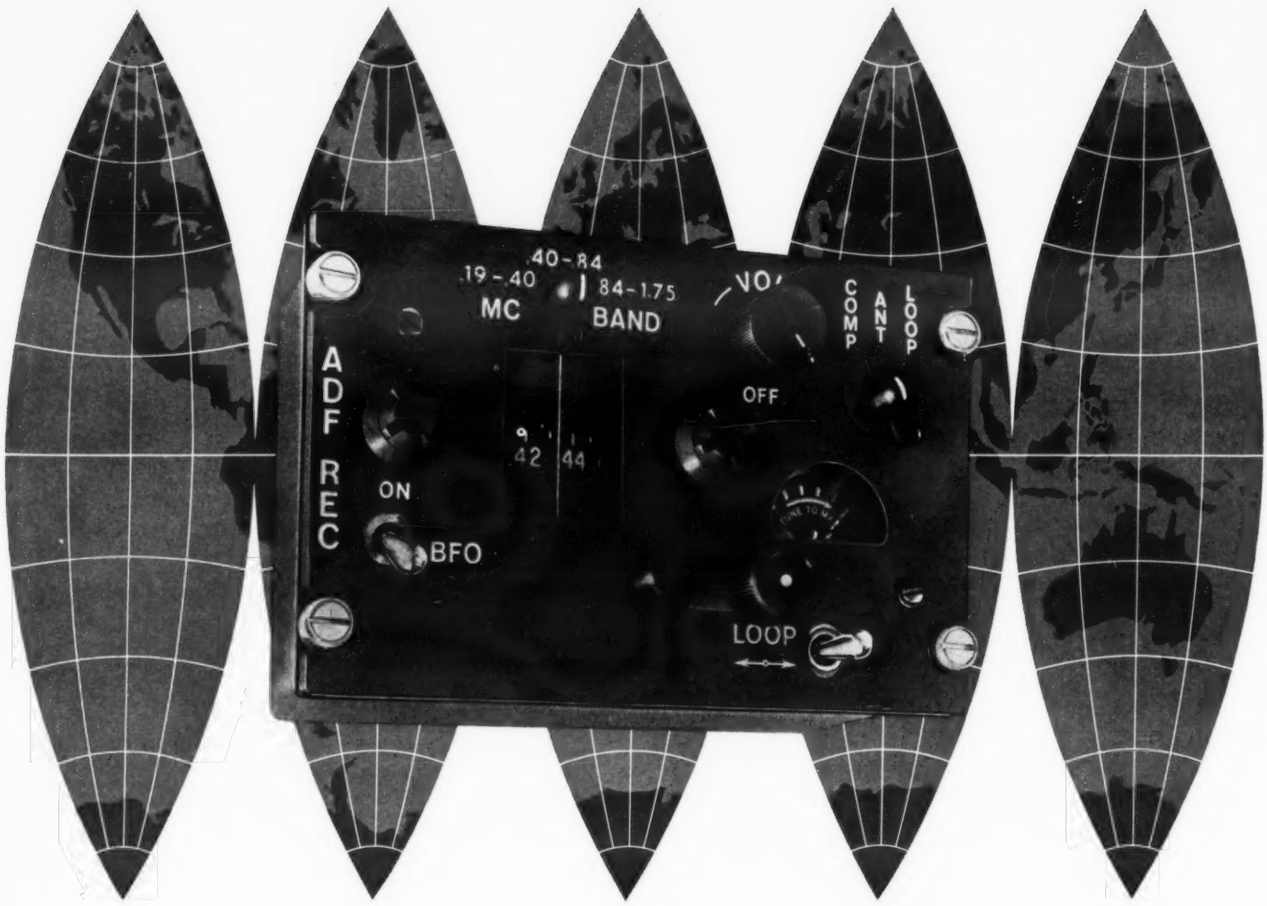
The Dart Herald is the ideal transport for branchline routes. With smooth-running propjet power-plants, it cruises at 275 m.p.h. and carries 43 passengers or more than 4½ tons of freight—or combinations of both.
Its range is 1,400 miles with a 6,200 lb. payload.

Cheap to operate, easy to maintain, comfortable to travel in, the pressurised Dart Herald—with its renowned Rolls-Royce engines—is made-to-measure for short- and medium-range air routes anywhere in the world.

DART *Herald*

Engines: Two Rolls-Royce Dart Propjets

HANDLEY PAGE
RADLETT LONDON READING



TYPE 21 A ADF WEIGHS ONLY 19.7 POUNDS

Component Unit Weights :

Receiver, 6.8 lbs. ; Loop, 4.3 lbs. ; Loop Housing, 0.5 lbs.;
Indicator, 1.3 lbs. ; Control Unit, 1.6 lbs. ; Power Unit, 5.2 lbs. ;
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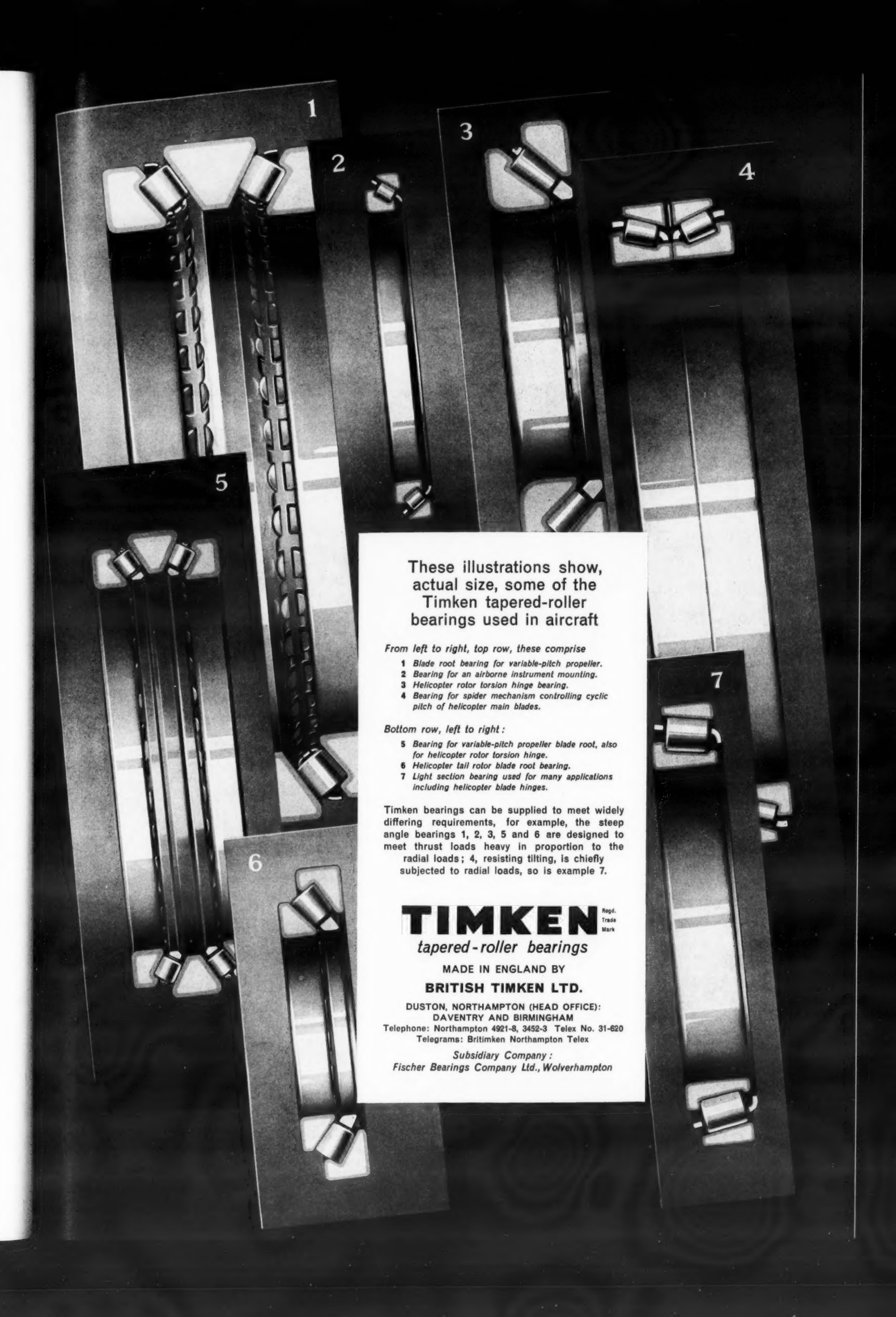

These illustrations show, actual size, some of the Timken tapered-roller bearings used in aircraft

From left to right, top row, these comprise

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2 *Bearing for an airborne instrument mounting.*
3 *Helicopter rotor torsion hinge bearing.*
4 *Bearing for spider mechanism controlling cyclic pitch of helicopter main blades.*

Bottom row, left to right:

5 *Bearing for variable-pitch propeller blade root, also for helicopter rotor torsion hinge.*
6 *Helicopter tail rotor blade root bearing.*
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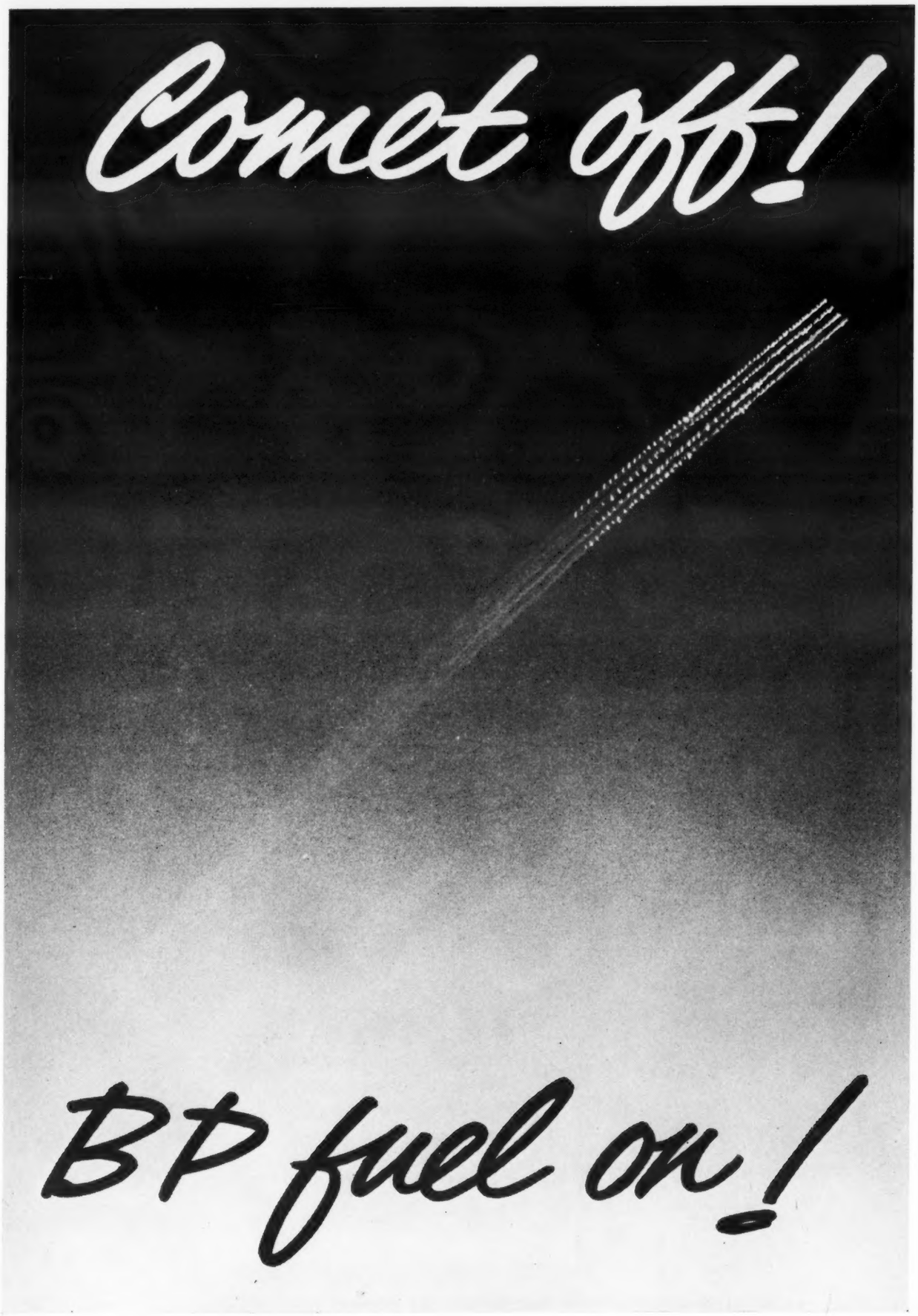
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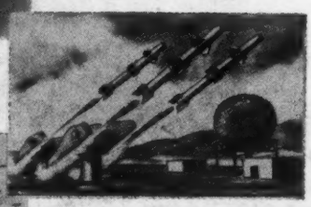

Developed and produced by RCA, the Time Division Data Link system employs digital transmission to transfer control information between ground environments and airborne systems. The use of digital techniques of high speed computers brings the concept of automation to the field of communications and guidance of airborne weapon systems. For further information contact Defense Electronics Products, Radio Corporation of America. United States Government clearance based on need-to-know is required.

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The FAI's 51st General Conference Los Angeles, April 11th—16th, 1958

The Fédération Aéronautique Internationale held its 51st General Conference in Los Angeles from April 11th to 16th, 1958. At the President's table: Jacqueline Cochran (FAI President for 1958 – 59); to her right (with spectacles) Dr. Charles Sillevaerts, Belgium (FAI President for 1957 – 58) and (standing) T. G. Lanphier (Convair); second from left Captain K. J. B. Bartlett (Great Britain).

A few days ago a somewhat nostalgic report appeared in the press. For months, it said, Belgium's Aero Club has been urging that the Gordon Bennett balloon races, which have fallen into oblivion since World War II, should be revived, as an added attraction to the Brussels World Fair. But the suggestion finally had to be turned down when the air transport experts objected on the grounds that balloon ascents would hamper operations at Brussels-Melsbroek Airport.

For years the competitions for the cups presented by James Gordon Bennett, publisher of the "New York Herald" (for motor racing from 1900 onwards, free balloon races from 1906, aeroplane races from 1909) had been major international sporting events. But today it is doubtful whether the younger generation has even heard of the name of Gordon Bennett.

*

Fate has been less unkind to the *Fédération Aéronautique Internationale*, the oldest international aviation organization. But even FAI has lost something of its earlier brilliance. Why?

The reasons are many. After two World Wars and the social upheavals they have brought with them, wealthy sports flyers are becoming rare. But above all aviation and sports flying have parted ways. When the FAI was founded, in 1905, they were still identical. The Wright Brothers' first powered flight was barely two years old. Farman was about to fly the first kilometre in a closed circuit. And it was not until four years later that Blériot was to venture over the open sea on his cross-Channel flight. In those days the fate of all branches of aviation lay in the hands of the FAI. True, its statutes say it was founded as an "international supervisory organ for all forms of sports flying", an association of the national Aero Clubs. But what else was there in those days . . . no air transportation, military aviation, aircraft industry. In a sense the FAI played the role of ICAO, IATA, AICMA and many other present-day organizations. It was everything in one.

Small wonder that in the carefree days before 1914 and even between the wars countless enthusiasts of brilliant name or well-filled purse should have sponsored the FAI, that it became a meeting ground for all who flew, had flown or were simply interested in fostering aviation. Patrons like Prince Bibesco, one of the first FAI Presidents, or Prince Kinsky, Austria's *grand seigneur*, set the tone of the International Federation's events. Mademoiselle Deutsch de la Meurthe, true to her family's traditions, made generous donations for FAI contests. Here, too, the name of *Interavia*'s first Board Chairman, Colonel Emil Messner, should not be forgotten, as a typical example of this private support for sports flying. As Central President of Switzerland's Aero Clubs, he devoted all his energies to Swiss and international flying.

*

After World War II, the 39th General Conference at the Royal Aeronautical Society's London premises in September 1946 seemed to promise a new lease of life. New prizes were donated, and the enrolment of new supporters for sports flying showed that the FAI was not defeated. Nevertheless, an unmistakable air of melancholy hung over the meeting. Chief spokesman Group Captain Preston (Royal Aero Club of the United Kingdom) movingly described the lamentable conditions of the national sports flying associations and the countless difficulties they faced in their efforts to resume activities . . .

For several years after this little was heard of the FAI, whose sole task seemed to be to guard the half-forgotten list of competition rules and records. In April 1958, however, the FAI came into the news again.

Colonel David G. Simons (centre) receiving the FAI Gold Medal for his balloon ascent into the stratosphere, from Jacqueline Cochran (FAI President) and Dr. Charles Sillevaerts (FAI Honorary President).

The 51st General Conference held in Los Angeles elected its first woman President, Jacqueline Cochran, whose name may yet give the FAI new lustre.

Jacqueline Cochran, holder of many world records, Lieutenant Colonel in the USAF, wearer of high decorations, was the first woman to break the sound barrier, in 1953. Even after she married American financier Floyd Odlum (today President of the Atlas Corporation) in the thirties, she continued to be an enthusiastic pilot. The fact that the Atlas Corporation at one time had wide aviation interests (minority holding in Convair, majority in Eastern Air Lines) and still has considerable financial interests in the industry, is in large measure due to Jacqueline Cochran. Moreover it was she who found the funds with which the then almost unknown Major de Seversky established the Seversky Aviation Corporation, out of which has grown today's Republic Aviation Corporation.

*

In broad outline what happened in Los Angeles was as follows:

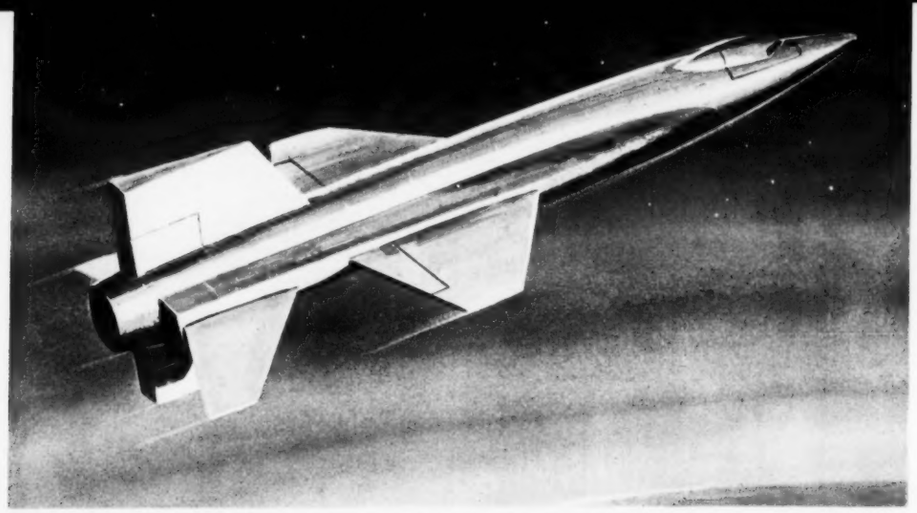
The Gold Medal for 1957 was awarded to USAF Colonel David G. Simons, who reached a record altitude of more than 100,000 ft. in a balloon and remained 32 hours in the stratosphere.

Retiring FAI President Dr. Charles Sillevaerts (Belgium) was unanimously acclaimed Honorary President. First Vice-President for 1958 is Jacques Allez (France); other Vice-Presidents: Dr. J. Gaisbacher, Austria; General Charles Sillevaerts, Belgium; Captain J. Foltman, Denmark; Carl Francke, Germany; Captain K. J. G. Bartlett, Great Britain; General Napoleone Del Duca, Italy; Robles Ochoa, Mexico; M. C. Kolff, Netherlands; D. Federico Norena Echevarria, Spain; Major General Nils Soderberg, Sweden; Dr. W. Muri, Switzerland; Captain J. J. Ide, USA; S. Staritchevsky, USSR; Slobodan Sakota, Yugoslavia.

Shortly before the opening of the 51st General Conference, the FAI Sports Flying Committee met and unanimously elected the following officials for 1958: Chairman, Captain John Jay Ide (USA, NACA representative in Europe up to the outbreak of war); Vice-Chairman, J. P. Yperlaan (Netherlands); Secretary, J. Blériot (France).

The 52nd General Conference is to be held in Moscow in May 1959.

Building the First Space Aircraft



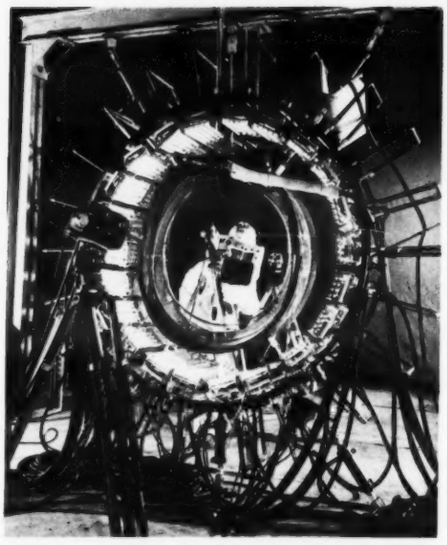
North American has recently released the first authentic drawing of the X-15 high-altitude research aircraft, which is now approaching completion at the company's Los Angeles plant. Outstanding features are the wedge-airfoil fixed-surface dorsal and ventral fins, and the long bulges along either side of the fuselage. The control surfaces comprise two ailerons mounted towards the centre of the wing trailing edge, a slightly swept apparently all-flying tailplane, and a pair of fan-shaped spoilers on either side of the two fins, near the trailing edges.

Half aircraft, half rocket, the North American X-15 is now approaching completion. As a research vehicle for the investigation of flight on the edge of space, the projectile-like aircraft will be employed for study of the effects of frictional heat during re-entry into the earth's atmosphere, and for testing the pressurized gas-jet attitude controls outside the earth's atmosphere. Over and above these tasks the X-15 will also provide an opportunity for studying the psychological and physiological effects on the pilot of weightlessness and rapidly accelerated flight processes—the first steps in training for manned space flight.

The external appearance and probable structure of the X-15 have already been discussed in the April 1958 issue of *Interavia* Review, together with details of the planned research programme and the funds made available for this revolutionary project. Some idea of the countless detail problems which have had to be overcome in the construction and testing of the largely steel airframe is given by North American's recently published report on the development of the X-15.

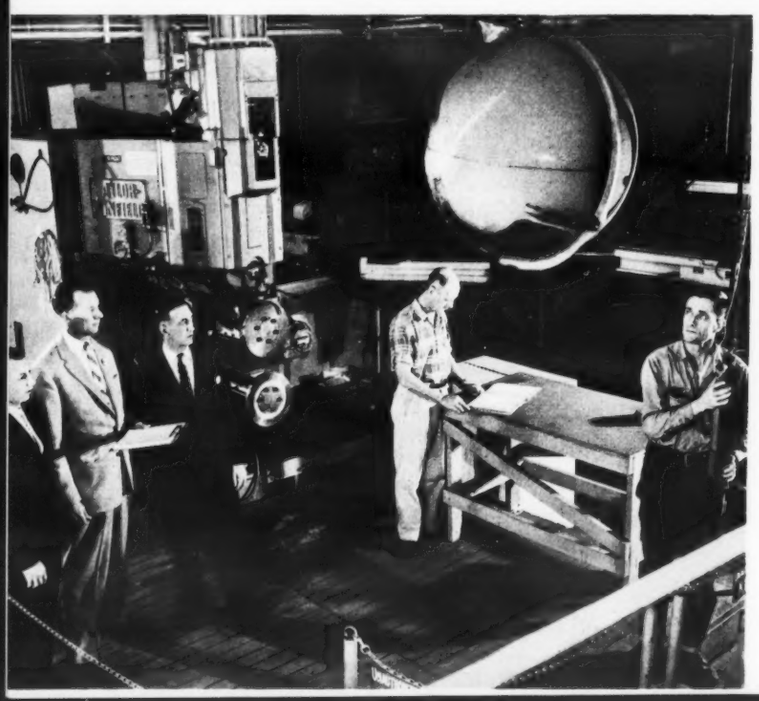
North American engineers have had to utilize new-type steel and nickel alloys, which have only just recently become available to the missile industry, in order to counteract the tremendous frictional heat which will be generated in the rocket aircraft's surfaces on high velocity re-entry into the earth's atmosphere, after its brief and noiseless journey into space. It is obvious that such materials are not so easily worked as the standard light metals, but valuable

Jim Hurzeler, group leader Welding in the Production Development Laboratory, and Test Engineer Gordon Watts, examine a part of the cylindrical fuel tank for the X-15. These separator baffles are to counteract the surge of the liquid propellant in flight.

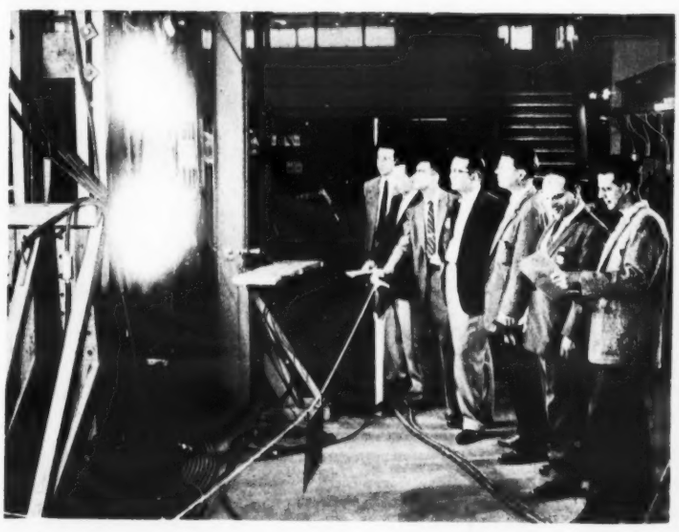


Drastic testing of a fuselage component. Batteries of infra-red lamps are used to heat the outside, while the inside is cooled by cold air blown through aluminium tubes. Cameras are used to record distortion.

A seam-welded spherical tank for the X-15. In the background is a Taylor-Winfield automatic seam-welding machine.

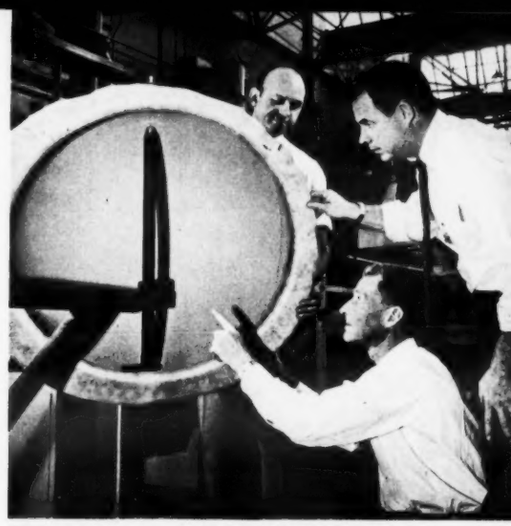


High-temperature testing of a wing section. A stretch-bed applies precisely controlled and varying structural loads and temperatures to the test piece, to simulate the conditions arising on re-entry.

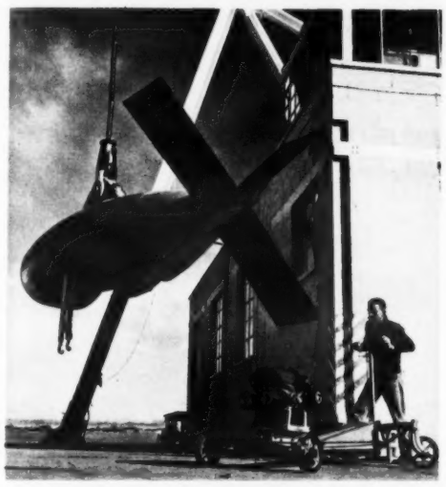


Thermodynamics Laboratory engineers discuss an experiment in which the wing leading-edge configuration is tested in a high-temperature nozzle exhaust to determine resistance to the frictional heats generated on re-entry.

Countless structural tests of X-15 airframe components have been electronically recorded, with particular emphasis on time and temperature programmes.



The hemispherical end of an X-15 pressure vessel is inspected after drawing and spinning. In the working of titanium and steel North American experience with the F-100 and XSM-64 has proved of great value.



This streamlined gondola (above) is loaded with a 200 lb. man-sized dummy equipped with the specially developed North American emergency ejection parachute. The centrifuge (below) whirls the gondola at high speed and the "pilot" is ejected to test the operation of the parachute.

knowledge in the handling of "hard metals" has been gained from the Missile Development Division's experience with the XSM-64 *Navaho*, and by the Los Angeles Division with the F-100 *Super Sabre*.

If it is realized that during re-entry certain surface areas will be subjected, within a matter of seconds, to temperatures up to approximately 600 °C (in fact the wing and control surface leading edges will be subjected to temperatures of over 1,000 °C) while others will be at —185 °C, then the problems facing the aerodynamicists, stress analysts and, by no means least important, the equipment engineers can be appreciated. To enable the aircraft to stand up to the inferno of air friction to which it will be subjected in repeated re-entries, the designers have opted for a complete external armour of nickel alloy. Heat which penetrates this resistant coating will meet titanium or steel skins, which themselves lose little or none of their strength even at very high temperatures. Some aluminium is in fact used internally in the X-15, where high temperatures or loads are not a problem.

To save weight, chemical milling (Chem-Mill) will be used extensively in the manufacture of the side panels. Some 65 percent of the entire X-15 airframe will be welded structure, and only 35 percent will be riveted or bolted. In this respect the new experimental aircraft is comparable to a guided missile, but whereas the latter are normally only one-time vehicles, the X-15 is scheduled to make repeated flights for various experimental requirements. In the X-15 construction, welding must be as good as the parent metal; North American engineers are employing both fusion welding, in which material is added, and resistance welding methods. To reduce the possibility of leaks in the entire pneumatic and hydraulic systems, North American has developed a method of brazing hydraulic tubes together, to eliminate tube-end threaded fasteners.

It is clear that the wide temperature differences which will arise inside the airframe, together with the sudden build-up of heat on the external surfaces, have not only demanded a careful and painstaking selection of suitable materials, but have also posed particular constructional problems in order to provide optimum rigidity of the airframe under all heat, air and G loads; without this quality the materials employed might well be able to resist the thermal loadings, but would be deformed to a degree where the control and safety of the aircraft could no longer be guaranteed.

Interavia hopes to be able to report further details of this manned space vehicle, when the constructional work is completed and when flight testing starts.

High-pressure lines on the X-15 are brazed instead of nut-fastened, to provide tighter joints. A metal sleeve is placed over the tube ends and a special heating coil is wrapped on to the sleeve; heat melts a brazing alloy on the sleeve and tube ends to form a gas-tight joint. The fuselage section mockup in the right of the picture carries four high-pressure lines, the uppermost of which is fitted with a metal brazing sleeve and heating coil.

The three men who will first fly the X-15 are: Scott Crossfield (left) of North American; Captain Iven C. Kincheloe (centre) of the USAF Flight Test Center, Edwards AFB; Joseph A. Walker, NACA's Chief Pilot.

Rockets, Missiles and Space Vehicles

• Moon Vehicle Projects

The only facts which can be sifted out from the mass of rumours and speculations in the press about moon projects are as follows:

The first practical moon vehicle will be the Air Force *Thor-Vanguard* Stage II combination. This vehicle can carry a 20 to 50-lb. payload to near the moon, with no guidance in the last stage. The Air Force is still evaluating *Vanguard* Stage III with solid propellant.

Certain difficulties which are being experienced with the 130,000-lb. North American Aviation rocket engine suggest that the *Thor* first stage for the projected moon vehicle will not be ready until the autumn of this year, so that the launching of the first moon vehicle will probably be delayed beyond the six months originally envisaged.

Problems have also arisen with the powerplant (also developed by North American Aviation) for the Army's *Jupiter* rocket, and no launching attempt for the Army's projected *Jupiter-Vanguard* Stage II moon vehicle can be expected before the winter.

The USAF's Office of Scientific Research is again sponsoring balloon-launched multi-stage solid-propellant rocket combinations, perhaps carrying 6 lb. into outer space, either near or on the moon. This scheme was first presented at the Rome IAF meeting in 1955 by K. Stehling and R. Foster. Launching problems, however, are tremendous, as the huge plastic balloon must be absolutely stationary at the moment the rockets are launched, and areas of zero wind are extremely rare at the altitude projected. The USAF has appointed Aeronutronic Systems Inc. of Los Angeles as systems contractor for the project, and first launchings may be attempted next autumn with clusters of *Nike-Zeus*, *Nike-Hercules* (or *Sergeant*) plus ASP plus *Loki* solid-propellant rockets.

A four-stage version of the Vanguard with a 4-lb. satellite is also under consideration. The payload would include a l-watt Minitrack transmitter permitting tracking up to 300,000 miles.

To sum up, it can be said that difficulties with first-stage rocket engines and tracking equipment will have to be overcome before there can be any question of successful landings on the moon. Another big problem is how a satellite's landing on the moon can be detected and recorded.

• U. S. Satellite Projects

The capability of unmanned satellites for obtaining early warning of ballistic missile attack appears to be more important in current U.S. military planning than the optical surveillance possibilities, *Interavia*'s Washington Correspondent writes. The United States has assigned the same priority to the development of reconnaissance satellites for early warning purposes as to the long-range ballistic missiles themselves. It is expected that the first experimental satellites will be launched this year.

The means by which a reconnaissance satellite circling the earth at an altitude of 250 miles might detect a long-range ballistic missile launching have not been disclosed, but it is not unlikely that very high frequency radio receivers employing MASER (Microwave Amplification by Stimulated Emission of Radiation) circuits might be envisaged for such application. These highly sensitive receivers could detect the characteristic electro-magnetic "signature" of a large rocket engine blast from much greater distances in satellites circling the earth than they could from ground stations located around the periphery of the Soviet Union.

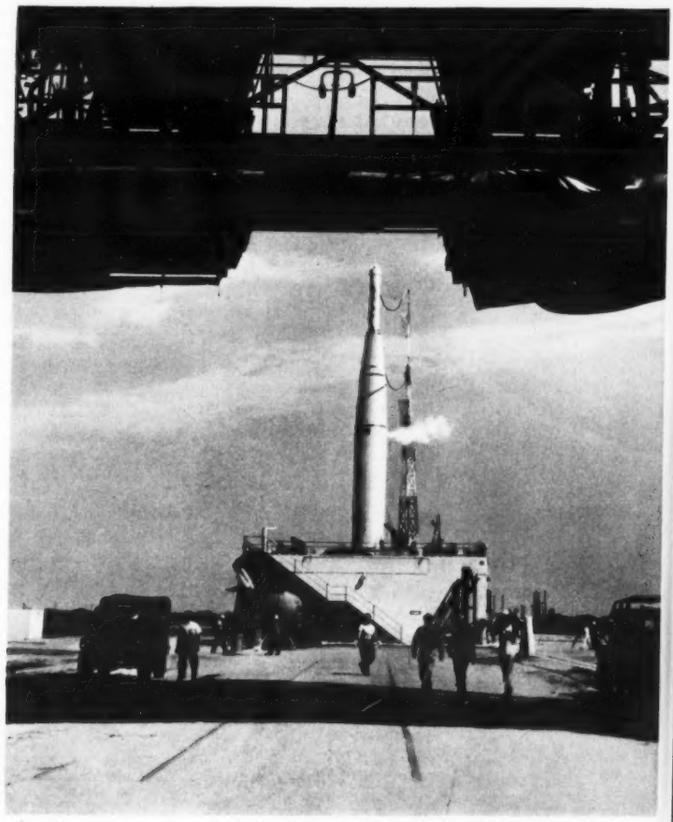
The USAF has now released the first drawing of the two-stage Martin *Titan* intercontinental ballistic missile. The method of mounting the second stage (the upper cylindrical portion with conical nose) into the first stage is similar to that employed in the *Vanguard* satellite rocket.

• The "Zenith" Satellite

It seems that the USAF may now have overtaken the Navy and the Army in the development of a stationary

A Douglas Thor IRBM (guided missile No. 101 according to the official caption) is prepared for launching at the Cape Canaveral Missile Test Center. Visible behind the IRBM on its launching pad, is a trough-shaped channel to lead off the exhaust gases into a rectangular pool.

A whole series of *Jupiter C* and *Thor* rockets have been test-launched from Cape Canaveral for re-entry experiments, with widely varying design nose cones and at extreme velocities. The *Thor* pictured here has a modified Vanguard second stage which carries a rounded nose cone. A combination of *Thor* and *Vanguard* second stage will be utilized to bring an instrumental payload to the vicinity of the moon.

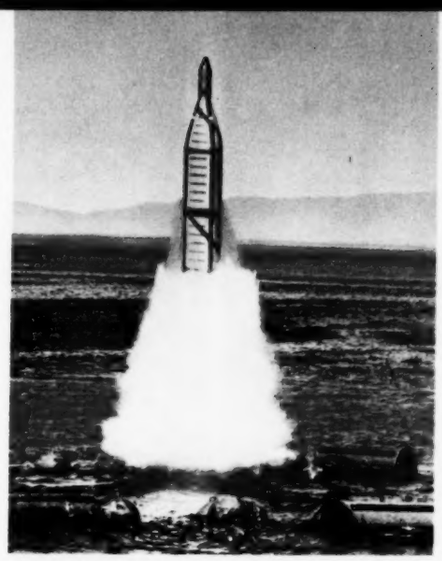


or "Zenith" satellite. One group of Air Force scientists holds that such a satellite, at a height of 22,500 miles and orbiting at a speed matching the earth's rotation, is the best solution to the reconnaissance platform requirement. Launched in the plane of the equator, the satellite would maintain a stationary position in relation to the earth. This development would ease the extremely difficult stabilization and optical problems presently faced in the *Pied Piper* project, a low-level reconnaissance satellite.

• Third Soviet Earth Satellite

According to a TASS report, the third Soviet Union earth satellite, launched into orbit on May 15th, 1958, has a gross weight of 2,925 lb., of which 2,134 lb. is the instrumental payload. The new satellite has attracted considerable attention from scientific circles; it is about one hundred times larger than the United States *Explorer I*. The scientific and military potential of a satellite with such a payload is obvious.

Transmitting on frequencies 20.005 and 40.002 Mc/s, the Russian satellite is circuiting the earth in 106 minutes in an elliptical orbit with apogee at 1,178 miles and perigee 93 miles. Separated from the final stage of the carrier vehicle, the satellite is conical in shape with 5.67 ft. diameter base and height 12.3 ft.



The U.S. Navy and Lockheed are carrying out underwater launching experiments with full scale models of the *Polaris* IRBM, in south Californian coastal waters. The test model is housed in a launching cylinder anchored to the sea bed, and propelled to the surface by pressurized gas. The first stage is not fired until the missile is clear of the water.

Preparations for launching the Vanguard TV-3. The fuelled missile is being subjected to a final check and the steel tower with its maintenance platforms has already been rolled away.

Fred S. Miller, manager of Solid Rocket Propellant Production with Aerojet-General Corp., Sacramento, with a new Aerojet rocket motor. In his right hand Miller is holding the first Aerojet-developed 25 lb.-thrust JATO unit, successfully tested at March Field in 1941. Since that date Aerojet has produced not less than 600,000 solid and liquid propellant rocket motors.

The British company Microcell Ltd. has developed a glass fibre reinforced plastic rocket launcher to mount 37 unguided air-to-air rockets, seen here installed beneath the wing of a Gloster *Javelin Mk 7* all-weather fighter. To reduce drag the front of the launcher has a plastic cover. On the left of the Microcell launcher is a de Havilland *Firestreak* rocket which, like the launcher, is installed on a standard weapon rack.

A carrier-borne North American FJ-4 *Fury* navy fighter is being loaded with the Martin *Bullpup* air-to-surface guided missiles. Now in service with the U.S. Navy, the rocket bombs are specially designed for utilization against armoured targets and can be launched at low altitudes. The FJ-4B can mount six of these 600-lb., 11-ft. long missiles.

The IBM 704 room is a key facility in Northrop Aircraft Inc.'s new COMPADAC (compution and datamation centre), and plays an important role in the design of new aircraft and missiles. COMPADAC makes possible, for example, the solution of problems with five or more degrees of freedom (e.g. oscillations about all three axes, and concurrent oscillations in the horizontal and vertical planes), and permits the simultaneous solution of five differential equations.

First picture of the Douglas *Sparrow II* air-to-air guided missile which is now in production at Canadair for installation in the Canadian Avro CF-105 supersonic interceptor. Built in conjunction with Canadian Westinghouse Company and Douglas (as the development firm), the weapon has a completely self-contained target radar and reaches several times the speed of sound.

What's in the Air?

Extracts from Interavia Air Letter, *daily international news digest, in English, French and German. All rights reserved.*

AIR TRANSPORTATION

● **Trans-Canada Air Lines** has been operating a weekly Zurich—Paris—Montreal service since May 18th. Some 50 representatives of Swiss Government agencies, the press and travel agencies were invited to take part in a pre-inaugural flight and to spend several days in Canada as guests of TCA. A report on Canadian air transport is to appear in the August edition of *Interavia*.

Top left, Gordon R. McGregor, TCA President; top right, J. Patrick Labrie, TCA Manager for Switzerland. Lower picture, right to left: Dr. Emil Landolt, Zurich City President, Dr. Paul Meierhans, Head of the Zurich Cantonal Building Directorate, Dr. E. Steck of the Swiss Federal Air Office, and Dr. F. J. Kaestli, Swiss Consul-General in Montreal.

● **The United States scheduled airlines** took in more than $ 2,000 million in revenues last year for the first time in their history, according to "Facts and Figures", the statistical year-book of the U.S. scheduled air transport industry. While they were setting a record for revenues, they were beset by mounting operating expenses that cut the year's profit to a little more than $ 42 million, the lowest level since 1950 when revenues were about one third of those in 1957. According to the same source, 1957 was a record year in terms of traffic operations. On domestic and international services, a total of 49,339,000 passengers were carried (45,943,000 in 1956), and 4,032,263,000 revenue ton miles were registered (3,527,437,000 in 1956). In his introduction, Stuart G. Tipton, President of the Air Transport Association said that although 1958 will see jets begin regular service, the phrase "Jet Revolution" is no longer appropriate because the advent of jets will not find the industry unprepared. Rather it will be the logical climax of studies that began years ago, long before the first jet prototype took to the air.

● **Canadian Pacific Airlines** is to increase the frequency of its Vancouver–Amsterdam Arctic route service from three to four flights a week. Two of the services will be flown with Bristol **Britannias** and the other two with DC-6Bs. The **Britannia** flights will be non-stop (with optional intermediate landings at Frobisher Bay) and flying time will be a little over 13 hours. The DC-6B services will be routed via Edmonton and will take 18 hours.

● **The Iberia Board of Directors** has decided to place an order for two Douglas DC-8 jet airliners and acquire an option on a third. The deal is subject to Government approval.

● **The Royal Air Maroc Board of Directors** has decided to place an order for two SE.210 *Caravelles*, the Com-

The Morane-Saulnier MS.1500 *Eperrier* lightweight two-seat low-level strike aircraft.

The Marconi Doppler Navigator Type AD 2300 which has been specially designed for air transport use, has been demonstrated in a Vickers *Viking* to government, airline and aircraft industry representatives in Paris, Rome, Zurich, Stockholm, Amsterdam, Cologne, Brussels and Blackbushe. Considerable interest was shown at all points.

Léon Adida, who has been appointed Technical and Industrial Director of Aeronautics in the office of France's Secretary of State for Air. He succeeds Engineer General Louis Meyer.

The 3/4-seat *Tuuli III* communications and training aircraft produced by Finland's Valmet Works. It is fitted with one 225-h.p. Continental O-470-A power unit. The production version is designated *Tuuli IV* and an unspecified quantity has been ordered; the *Tuuli IV* will be equipped with either a 240-h.p. Continental O-470-M or a 260-h.p. Lycoming G0-480-B1C.

Delivery of the first four of six *Whirlwind* helicopters ordered from Westland Aircraft Ltd. by the Austrian Government was made on April 29th, when they were formally handed over to General Paul Lube, Commander-in-Chief of the Austrian Air Force, at Yeovil, Somerset. The last two *Whirlwinds* are expected to be delivered shortly. Pictures show: Parade exhibition of the six Austrian *Whirlwinds;* E. Wheeldon, Director of Westland (left), accompanied by General Paul Lube (centre) and Colonel Gustav Hauck, Chief Helicopter Pilot and Instructor of the Austrian Air Force. At the rear, left: Colonel Walter Mühlbacher (right) and Colonel Franz Hofbauer, both of the Austrian Defence Ministry.

The Bristol *Britannia 305* ordered by Northeast Airlines has been awarded a commercial certificate by the U.S. Civil Aeronautics Administration. Deliveries of the five *Britannias* ordered are due to be completed during September and October. The way is now clear for the airliner to be used on United States domestic routes.

Visit to Turin: Air Force Chief of Staff General Thomas White paid an official visit to the Fiat works in Turin on May 7th. The American guest was shown the latest aviation products by Fiat President Prof. Valletta and Ing. G. Gabrielli, Manager of the Aviation Division. The picture shows General White accompanied by G. Gabrielli and G. Perosini, Manager of the Fiat Aircraft Plant.

pany's President M. Laraki announced at a press conference in Casablanca. The first of the two aircraft is to be put into service in the summer of 1959.

• **KLM Royal Dutch Airlines** sustained a loss of 6,794,000 guilders in the first three months of 1958 against 110,000 guilders in the same period last year. According to KLM President I. Aler, three factors were responsible for the deterioration—1. the economic recession in a number of countries; 2. the cancellation of KLM landing rights in Jakarta by the Indonesian Government; and 3. the strike of KLM pilots in March.

• **Swissair** has chartered a P.3 two-seat aircraft from Pilatus Flugzeugwerke A.G., Stans, for a six-month trial period to see if it is suited for use by the company as a basic trainer.

INDUSTRY

• **The Dornier works** have (in addition to the thirteen Do 27 touring and liaison aircraft supplied to the German armed forces) sold Do 27s to civilian customers in the following countries: four in the German Federal Republic, seven in Switzerland and two in South Africa. These figures were revealed by Dornier in mid-May. Dornier's efforts to build up a civilian market in Germany and abroad are being fully supported by the Federal Defence Ministry.

• **The Italian Government** has confirmed an order placed with Fiat for fifty G.91 light strike fighters. This order was placed in accordance with the decisions reached by the Defence Ministers of the German Federal Republic, France and Italy.

• **Aer-Lualdi and Aerometallurgica Regionale** (Aeromere) have included an agreement whereby the latter company will manufacture the Aer-Lualdi L.55 helicopter (four-seat version powered by an 185-h.p. engine) at its Gardolo, Trento, plant.

• **Vincenzo Agusta**, one of the four co-proprietors of Costruzioni Aeronautiche Giovanni Agusta and Meccanica Verghera, manufacturers of aircraft, helicopters and aircraft engines, died in Milan in mid-May at the age of fifty-one.

• **Convair** has installed a new $ 30,000 flight observation tower at Palmdale Airport, Palmdale, Calif., to be used as the primary radio control centre for Convair operations of the F-102A and F-106A undergoing production flight tests. More than 2,500 messages are transmitted monthly from the tower which replaces an older and smaller unit on the same site. The tower maintains constant communications with Convair test pilots from the time the aircraft leaves the ground until it returns. Pilots must check in with the tower operator at least once every ten minutes.

• **Armstrong Siddeley Motors** has announced another example of the diversification policy operating within the companies of the Hawker-Siddeley Group. Facing a cut-back in the Government need for aero engines, the company has signed a licence agreement to make Germany's Maybach diesel engine in Britain.

AIRCRAFT

• Lockheed Aircraft Corp. has confirmed receipt of a U.S. Navy contract valued at $ 2,000,000 for research and development work on an anti-submarine version of the Lockheed *Electra* to replace the currently employed P2V *Neptune*. The Navy has selected the *Electra* as the future weapon for this task, and Lockheed announces that a prototype is scheduled to commence flight testing in August 1958.

Three new world altitude records in three weeks: On April 17th, 1958, Lt.-Cdr. George C. Watkins of the U.S. Navy reached the new record height of 76,828 ft. in a Grumman F11F-1 *Super Tiger* naval fighter (top). However, two weeks later, on May 2nd, 1958, Roger Carpentier flew the Sud-Aviation *Trident II* interceptor to the height of 79,724 ft. This record was broken on May 7th by USAF Major Howard C. Johnson who reached the altitude of 91,249 ft. in a Lockheed F-104 *Starfighter* (bottom). This record has been submitted to the FAI for homologation.

• According to an announcement from the RCAF headquarters in Ottowa, the CL-44 transports ordered from Canadair Ltd. will be fitted with Rolls-Royce *Tyne II* engines, instead of Bristol *Orions* as previously planned. With *Tynes* the all-up weight of the four-engined aircraft will be 205,000 lb.; cruising speed 375 m.p.h. In the all-cargo version the CL-44 is to have a payload capacity of 66,500 lb; in the all-passenger civil version it will accommodate 150 "economy class" guests.

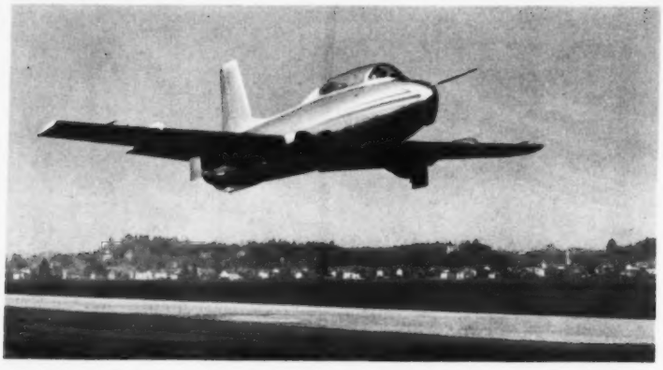
• The USAF is advocating the procurement of an unspecified number of *Fairchild F-27*s equipped for aero-medical evacuation service, and steps have been taken to obtain approval from the competent Government agency. The cabin layout of the F-27 Aero-Medical Evacuation version provides the following alternatives: a) 21 stretcher cases; b) 12 stretcher cases plus 14 seats for walking wounded; c) 9 stretcher cases plus 16 seats; d) 3 stretcher cases plus 24 seats. Three-man aircraft crew plus three medical attendants.

• Following the recent first flight of the first of the *Comet 4s* for BOAC (April 27th, 1958), the following important data are repeated for their general interest: Powered by four Rolls-Royce *Avon RA.29* Mark 524 engines, each delivering 10,500 lb thrust; gross weight 156,000 lb.; cruising speed 443 knots; normal cruising altitude 38,000–42,000 ft. Normal cabin layout for 56 first-class passengers, alternatively 67 mixed-class passengers (24 first-class and 43 tourist), or 71 tourist class.

The RA.29 Mark 524 engines have an approved overhaul life of 750 hours, with the prospect of an extension to 1,000 hours soon after the *Comet 4* enters service.

Currently offered variants of the *Comet 4* are: the long-range Intercontinental *Comet 4*, designed to carry 56 to 76 passengers on stages of up to 2,600 nautical miles; the short and medium-range Continental *Comet 4B*, to carry up to 100 passengers and intended primarily for economical operation on routes from 300 to 1,500 miles; and the Intermediate *Comet 4C* for routes taking advantage of the *4B* high seating

Another record for France: Breguet Test Pilot Bernard Witt set up a new speed record over 1,000 km in a Breguet 1001 *Taon* lightweight strike fighter on April 25th on the route Istres-Cazaux-Istres. Time 57 min 23 secs; average speed 649.7 m.p.h. – The *Taon* used for the record was fitted with a Bristol *Orpheus 3* jet of 3,850 lb. thrust.



The Macchi MB.326 two-seat jet training aircraft (fitted with Armstrong Siddeley *Viper ASV.8* of 1,750 lb. thrust). At the general meeting of Aeronautica Macchi, President Paolo Foresio reported on the successful flight testing of the MB.326, and said that there were interesting aspects for the sale of this type on the international market. At the same time Foresio mentioned an agreement that his company has recently reached with Lockheed Aircraft Corp., on technical cooperation.

Folland *Gnat* with jettisonable load: Two 500-lb. bombs and two 66 Imp. gals. auxiliary tanks.

Britain's Blackburn NA.39 naval combat fighter with two de Havilland *Gyron Junior* jet engines. The NA.39 shown here was the first to undergo flight testing at the end of April. By the end of 1958 further aircraft are expected to have commenced flight tests.

The Aerfer *Ariete* single-seat lightweight interceptor, which was designed by Engineer Sergio Stefanutti. The *Ariete* is powered by a Rolls-Royce *Derwent* jet in the forward fuselage (air intake in the nose; jet pipe beneath the fuselage, slightly behind the wing trailing edge) plus one Rolls-Royce *Soar RS.2* in the tail. According to Aerfer, the thrust of *Derwent* is 3,750 lb., and that of *Soar* 1,100 lb.

capacity but requiring a range capacity approaching the *Comet 4*.

● Nederlandse Helicopter Industrie N.V., manufacturers of the H-3 *Kolibrie* ramjet-powered light helicopter, has released the following revised data: Dry weight of each of the TJ-5 power units 21 lb.; each delivers a power output equivalent to 60 h.p. Weights: Civil version: Minimum weight equipped 529 lb.*; pilot, fuel, equipment and payload 904 lb.; take-off weight 1,434 lb. Military version: Minimum weight equipped 530 lb.*; pilot, fuel, equipment and payload 1,014 lb.; take-off weight 1,544 lb. (*Single-seat version; only one fuel tank; no windscreen or starter motor).

Main dimensions: Main rotor diameter 33 ft.; length 13 ft. 10½ in.; height 8 ft. 5 in.; diameter of the single-bladed tail rotor 2 ft. 9 in. Performance (with average take-off weight of 1,100 lb.): Speed at maximum continuous output 54 knots; speed at economical output 13–43 knots; reliable operation under wind conditions up to 30–40 knots; rate of climb 800 f.p.m. at a forward speed of 27 knots; endurance (with pilot only) approximately one hour.

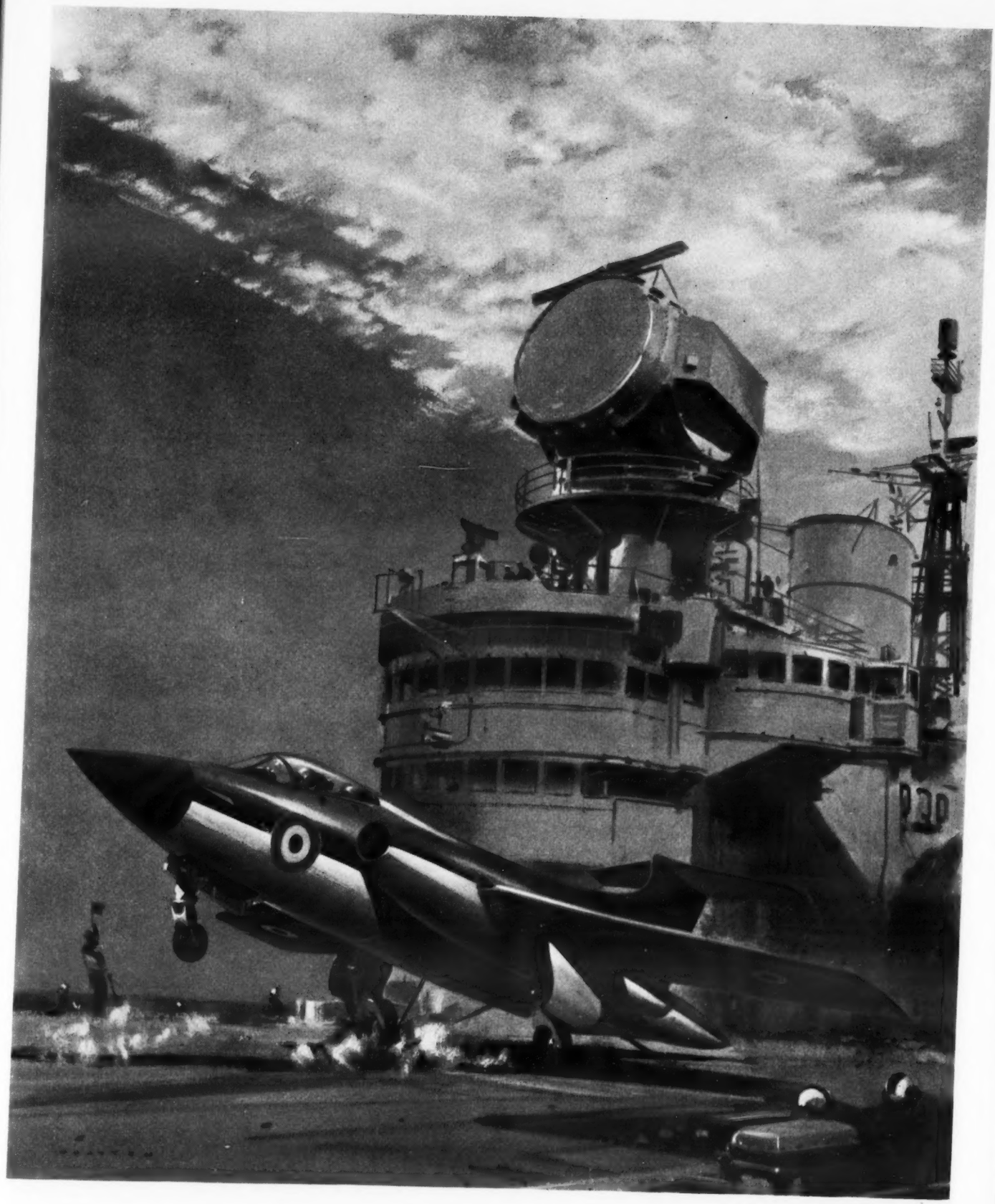
● SAN (Société Aéronautique Normande), Bernay, announces that air brakes for fitting to the *Jodel D 117* and *D 11* sports aircraft and later versions have been developed at the Aérodrome de Saint-Martin plant, and have now been officially approved. From May 1st, 1958, all D 117s constructed by SAN will be fitted with this refinement, without extra charge. The new air brakes will considerably improve the landing performance of the aircraft: landing distance, after clearing a 65-ft. obstacle, less than 394 ft. SAN also reports favourable sales figures for their light sports and touring aircraft, particularly in orders from South Africa, the Belgian Congo, Portugal and Austria, and market prospects in Western Germany are considered to be very good. SAN has to date manufactured over 200 Jodel D 117s, and the current monthly production rate is 9 aircraft. It is also intended to produce five Jodel D 140 *Mousquetaires* monthly as soon as this model has carried out its flight testing early in June this year. Factory testing of the D 140 is scheduled to begin immediately.

● Temco Aircraft Corp. is proposing an advanced, more powerful version of the *U.S. Navy's TT-1 jet trainer* to teach carrier landing techniques. Designated TTX, this new version will be equipped with a more powerful engine than the 920-lb. thrust unit for the TT-1 now in production for the U.S. Navy; the existing airframe can be utilized without major modification. Main differences in the two versions will be: fairing behind the cockpit slightly enlarged to accommodate extra navigation gear (TACAN); larger nose-wheel installed for carrier landings; landing hook and catapult lugs installed; additional fuel tanks in the wings; ground level ejection seats. The production model TT-1 will be powered by one Continental 920-lb. thrust J69-T2, but the prototype is also being tested with a 1,025-lb. thrust Continental J69-T25, and the latter unit may also be used for the TTX version. The Continental J69-T23 will also be studied for possible utilization.

The Breguet 940 STOL experimental aircraft, fitted with four Turboméca *Turmo II* turboprops of 400 h.p.

● During May the new *PZL M-2 two-seat trainer*, now in construction at the Mielec State aircraft plant in southern Poland, made its first flight. The aircraft will also be exhibited at the Poznan Industrial Fair to be held from June 8th to 22nd, 1958. Available details of the M-2 are: all-metal construction; manually operated landing flaps; monocoque fuselage construction with conventional tail unit; fixed tail-wheel undercarriage with hydraulic brakes (later versions are projected with retractable nose-wheel undercarriage). Power unit one Praga *Doris B* Type M-208B of 220 h.p.; a Polish manufactured powerplant is planned for the production model—either the 180-h.p. WN-6 or the 220-h.p. WN-6R. The prototype will have a fixed pitch wood propeller, while the production model is scheduled to have a constant speed metal propeller. Equipment includes the RSI-6K two-way radio, the KP-18 oxygen equipment and the SPU-2B intercommunications set. Main dimensions and weights: Span 31 ft. 2 in.; length 25 ft.; wing area 146.6 sq.ft.; aspect ratio 6.63; maximum gross weight 2,248 lb.; weight equipped 1,620 lb. Estimated performance: Maximum speed 151 knots; cruising speed 130 knots; landing speed 49 knots; rate of climb at sea level 1,280 f.p.m.; service ceiling 18,370 ft.; range 370 nautical miles; take-off distance from grass runways approximately 170 yards.

● Polish research centres have produced a device known as the "Thermovizor" which enables glider pilots to detect strong thermal up-currents. No details are available although practical testing is reported to have begun with a *Bocian* two-seat glider.



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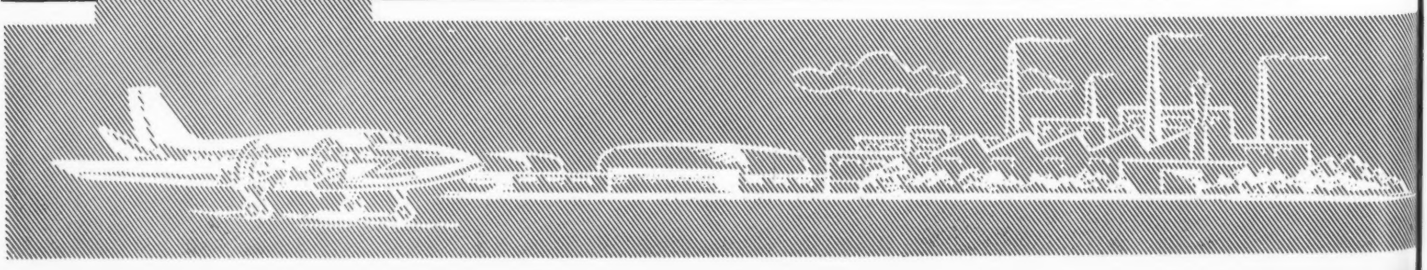
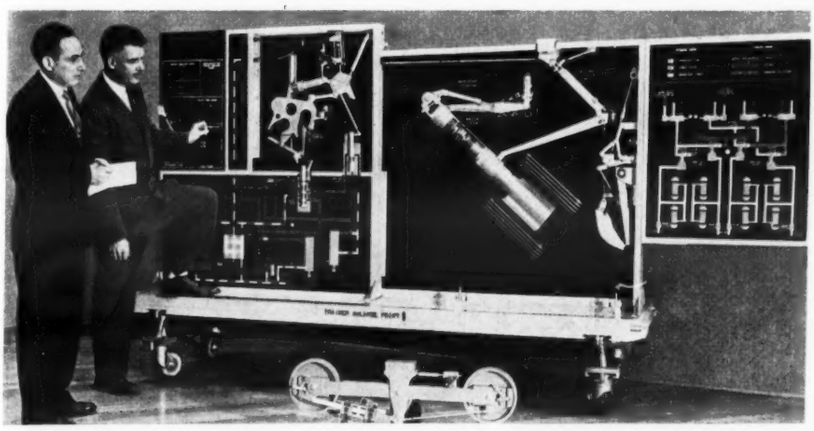
- PIRELLI S.p.A. – Milano, *Viale Abruzzi 94*
- RIV Officine di Villar Perosa S.p.A. – Torino, *Corso Vittorio Emanuele II, 8*
- SAMI – Società Aeromissili Italiana – Roma, *Via del Tritone 169*
- SECONDO MONA Officine Meccaniche Costruzioni Aeronautiche S.p.A. – Somma Lombardo (Varese)
- SHELL ITALIANA S.p.A. Serv. Aviazione – Roma, *Piazza Augusto Imperatore 32*
- VEAM S.a.r.l. – Milano, *Via A. Figino 16*



REPORT ON SERVICE SUPPORT

KEY MEN in the Boeing support program for 707 and 720 jetliners are service engineers assigned to customer airlines. Through them, the benefits of Boeing's unequalled experience with multi-engine jets—at all engineering, maintenance and management levels in the company—are available to airlines. Boeing service engineers have spent up to 10 years with multi-engine jets, and four years with the 707 jetliner prototype.

BOEING SPARES service is designed to hold airline costs to a minimum. To enable airlines to keep parts inventories low, Boeing stocks off-the-shelf spares and insurance parts, and can ship emergency requirements within hours of receiving the order.



TRANSITION TO JETS is being aided by complete Boeing training programs. They range from flight instruction for airline pilots to training courses for maintenance personnel, given by engineers with years of multi-jet experience. Complete manuals are available, and operable trainers, like the one illustrated above, are used to demonstrate 707 systems.

BOEING'S PROVISIONING program is built around an IBM system to speed service, simplify ordering and inventory control. Orders are reproduced on IBM cards, get immediate action.

These airlines already have ordered models of the Boeing family of jetliners:
AIR FRANCE • AIR INDIA • AMERICAN • B. O. A. C. • BRANIFF • CONTINENTAL • CUBANA • LUFTHANSA • PAN AMERICAN • QANTAS • SABENA • SOUTH AFRICAN • TWA • UNITED • VARIG

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Family of jet airliners

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NEAR EAST

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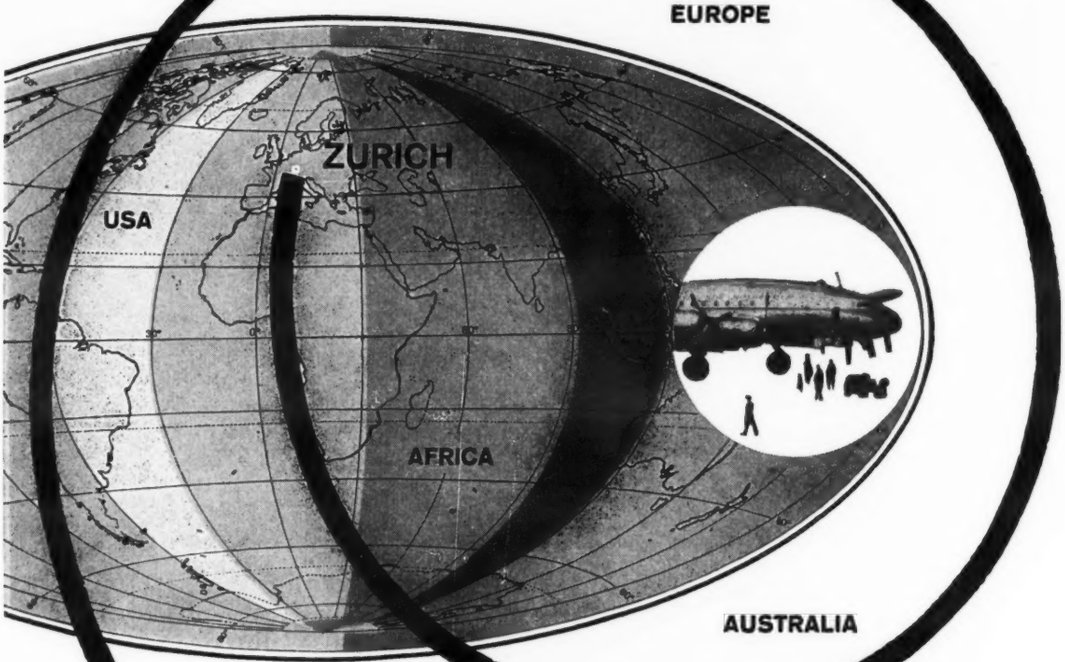
offers you direct flights
to all continents
and to the most important
cities of Europe

SOUTH AMERICA

EUROPE



AUSTRALIA

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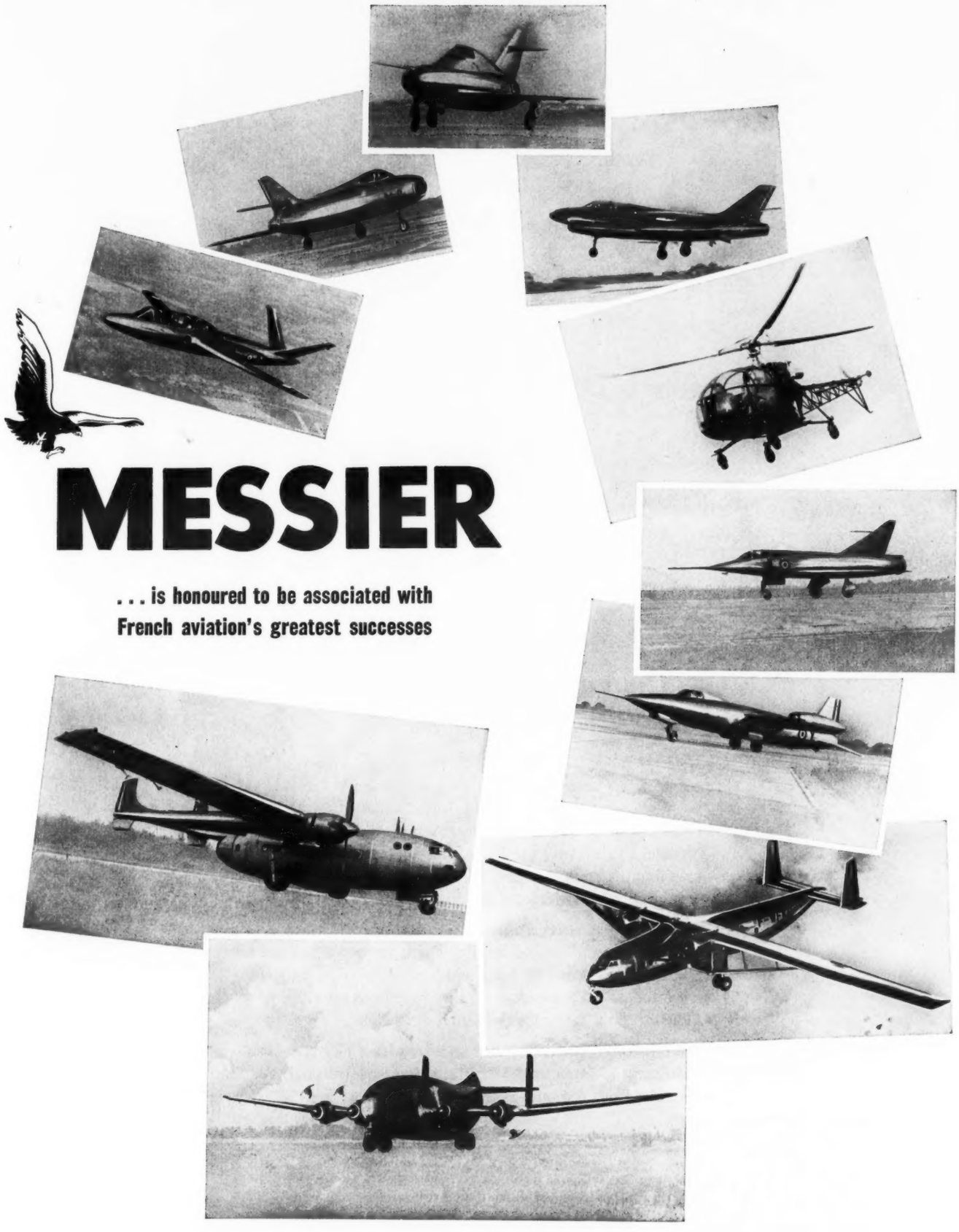

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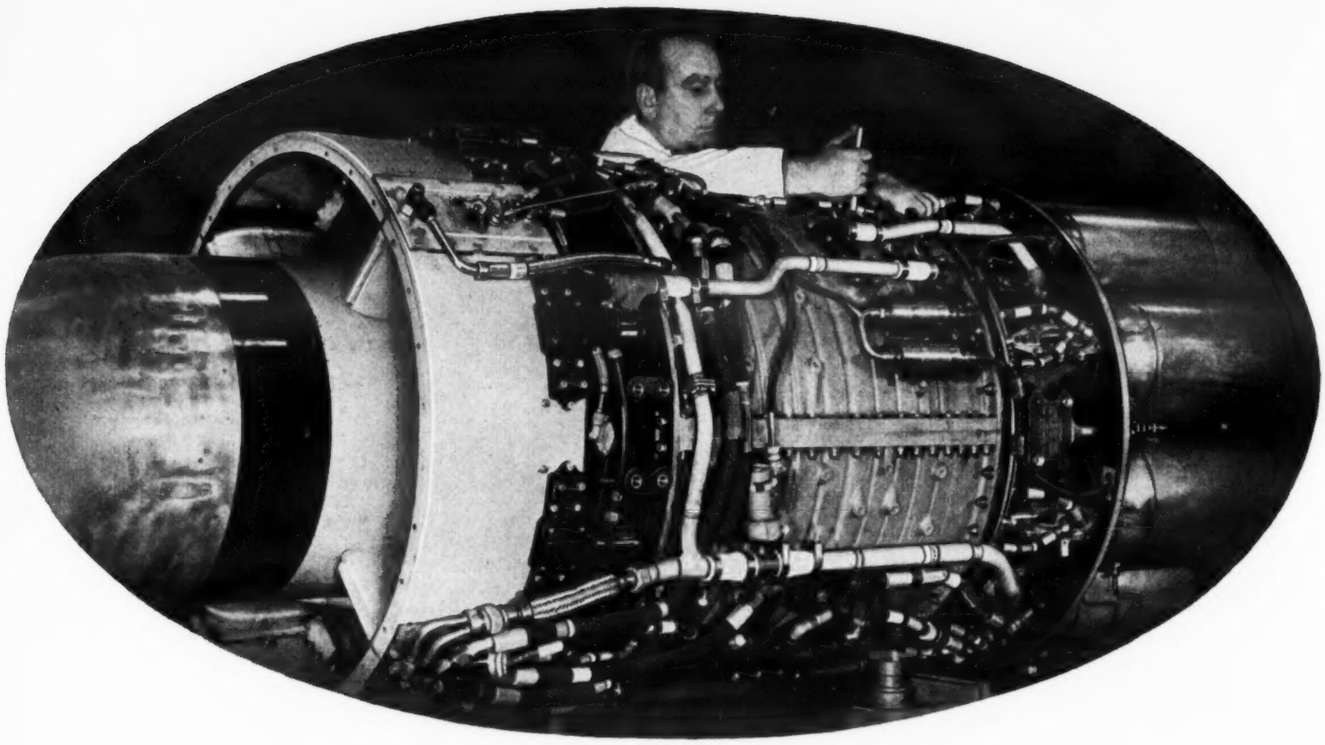

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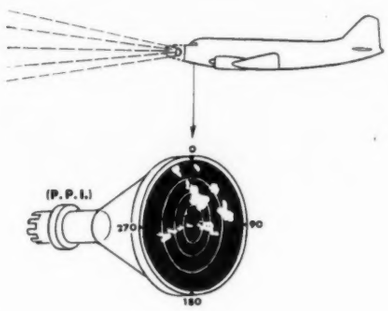
(Continuation)

4.3 Storm and collision warning airborne SHF radar

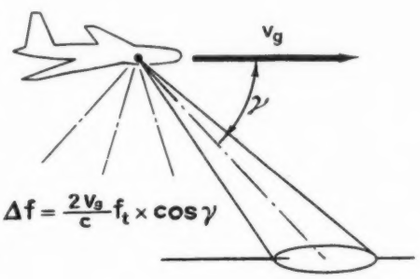
Weather radar equipment	Radar météorologique	Radar meteorológico	Wetterradargerät
Rotating or swinging radar antenna	Antenne radar tournante ou oscillante	Antena radar giratoria u oscilante	Umlaufende oder hin- und herschwenkende Radarantenne
CRT with synchronized rotating range sweep (PPI)	Tube cathodique à balayage tournant synchronisé	Tubo catódico de barrido giratorio sincronizado	Kathodenstrahlröhre mit synchron umlaufender Zeitachse (PPI)
Pencil beam	Faisceau en pinceau	Haz en pincel	Bleistiftförmiges Strahlenbündel



The weather radar has a rotating or swinging transmitter-receiver antenna, horizontally stabilized in the nose of the aircraft, which searches the airspace ahead of the aircraft with a pencil beam. The centimetric waves employed are not only reflected by solid objects, but also by storm areas and cyclone centres. The echoes received are displayed pictorially on a CRT which has a time axis synchronized to the antenna position; the angle and distance of the pictured echo from the centre of the scope gives bearing and distance of the obstruction. Due to the varying strengths of the echoes the CRT presents a shadow picture of the airspace ahead. Weather radar can also be utilized as a navigation aid; if the antenna is tilted a few degrees downwards then a picture of the terrain ahead of the aircraft is presented in which land and water are especially clearly defined.

4.4 Doppler Navigation

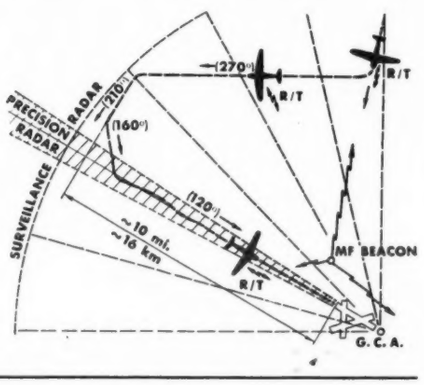
Doppler effect	Effet Doppler-Fizeau	Efecto Doppler-Fizeau	Doppler-Effekt
Doppler frequency (Δf)	Fréquence Doppler (Δf)	Frecuencia Doppler (Δf)	Doppler-Frequenz (Δf)
Transmitter frequency (f_t)	Fréquence d'émission (f_t)	Frecuencia de emisión (f_t)	Sendefrequenz (f_t)
Horizontal velocity component (V_g)	Composante horizontale de vitesse (V_g)	Componente horizontal de velocidad (V_g)	Horizontale Geschwindigkeitskomponente (V_g)
Propagation velocity of electromagnetic waves in space (c)	Vitesse de propagation des ondes électromagnétiques dans l'espace (c)	Velocidad de propagación de las ondas electromagnéticas en el espacio (c)	Ausbreitungsgeschwindigkeit elektromagnetischer Wellen im Raum (c)
Angle between V_g and radar beam (γ)	Angle de V_g et du faisceau radar (γ)	Angulo de V_g y del haz radar (γ)	Winkel zwischen V_g und Radarstrahl (γ)



From the aircraft four clusters of beams are directed at the ground, two ahead of and two behind the flight path. The Doppler shift in the echo frequencies permits the calculation of ground speed and drift. Together with the aircraft heading these values are fed to a computer which presents continuous information on ground speed, track, location, distances flown and remaining. The computer also produces a reference signal which may be fed either to a visual course deviation indicator, or to an automatic pilot to maintain a given course.

4.5 UHF/SHF (radar) ground controlled approach (GCA)

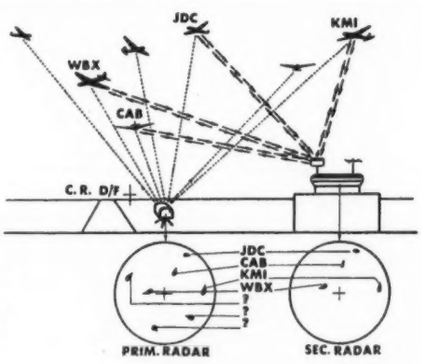
UHF/SHF surveillance radar (SRE) 50—80 n. m. radius	Radar UHF/SHF de surveillance (portée 50—80 milles marins)	Radar UHF/SHF de vigilancia (alcance de 50—80 millas marinas)	UHF/SHF Rundsichtradar (SRE) (50—80 sm Umkreis)
SHF precision approach radar (PAR)	Radar SHF d'approche de précision (PAR)	Radar SHF de aproximación de precisión (PAR)	SHF Präzisions-Anflugradar (PAR) mit Höhenmeßstrahl und Seitenmeßstrahl
R/T talk-down instructions	Instructions d'atterrissage en phonie	Instrucciones de aterrizaje en fonía	«Heruntersprechen» (durch Sprechfunk-Anweisungen)



Aircraft within the 50 n.m. range of the GCA UHF/SHF surveillance radar are displayed on a PPI scope in the control tower. Aircraft intending to land are talked into the zone of two SHF precision radar beams which scan the approach sector in elevation and azimuth; off-course deviations are communicated to the pilot by R/T. For talk-down GCA landings aircraft equipment can be confined to two-way VHF R/T.

4.6 UHF/SHF surveillance radar

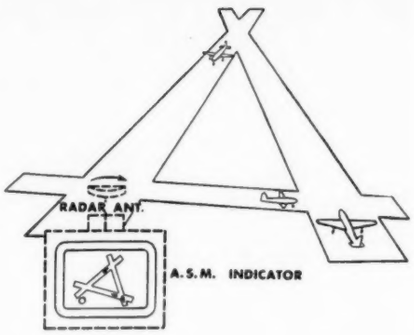
UHF primary radar	Radar primaire UHF	Radar primario UHF	Rundsicht-Primärradar
SHF/VHF secondary radar	Radar secondaire SHF/VHF	Radar secundario SHF/VHF	Rundsicht-Sekundärradar
SHF/VHF airborne responder	Répondeur VHF/SHF de bord	Respondedor VHF/SHF de a bordo	Bord-Impulswiederholer
Plan position indicator (PPI)	Ecran indicateur de gisement (PPI)	Pantalla indicadora de posición (PPI)	Luftverkehrs-Sichtgerät (PPI) mit drehender Zeitachse



UHF primary surveillance radar employs a rotating search antenna to detect all aircraft in the airport zone, particularly in bad weather, and presents them on a PPI scope display. This system can be supplemented by a secondary radar which detects only those aircraft equipped with transponders; transmitted SHF pulses with VHF transponder replies. Presented on a second scope these replies give aircraft identity and altitude. The secondary radar is more free from "clutter" and permits a differentiation between "friends" and "strangers". The system is completed by an automatic ground D/F equipment with R/T.

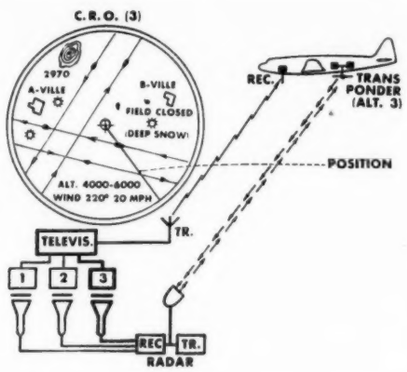
4.7 EHF airfield surface movement indicator	Radar EHF de surveillance des mouvements de surface sur les aéroports	Radar EHF de vigilancia de los movimientos de superficie, en los aeropuertos	EHF (Radar) Rollbetrieb-Überwachung
ASM indicator	Indicateur des mouvements de surface	Indicador de los movimientos de superficie	Rollbetrieb-Sichtgerät
VHF R/T taxiing instructions	Instructions de roulement au sol (en phonie VHF)	Instrucciones de recorrido en tierra (en fonía VHF)	Rollanweisungen (durch VHF Sprechfunk)

Control system for surface traffic on major airports in bad visibility conditions. All aircraft and vehicles are detected by EHF radar and displayed on a PPI scope on which a plan of the airfield is superimposed. Control instructions are given by VHF R/T.



4.8 UHF/SHF Television-Radar Air Navigation (Teleran)	Navigation aérienne par radar-télévision UHF/SHF (Teleran)	Navegación aérea mediante radar-televisión UHF/SHF (Teleran)	UHF/SHF Fernseh-Radar-Flugsicherungssystem «Teleran»
En-route radar	Radar de route	Radar de ruta	Strecken-Radar
Airport radar	Radar d'aéroport	Radar de aeropuerto	Flugplatz-Radar
Precision radar (for TV-GCA)	Radar de précision (pour GCA-télévision)	Radar de precisión (para GCA-televisión)	Präzisions-Radar (für Bildfunk-GCA Blindlandung)
Airborne TV receiver and radar transponder	Récepteur de télévision de bord et répondeur radar	Receptor de televisión de a bordo y respondedor radar	Bord-Fernsehempfänger und Bord-Impulswiederholer (mit Höhenstufenkennung)

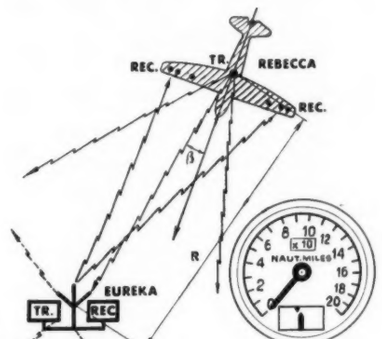
Projected combined TV-radar system which envisages a continuous pictorial presentation of all traffic movements (taxiing, instrument take-offs, flight at different levels, instrument approaches and landings) on the pilot's TV screen to assist in navigation, obstacle warning, weather and route reports, precision instrument landing, surface movement and traffic control. Ground radar scans the entire traffic, interrogates and, according to transponder replies, allocates specific levels and registers the entire situation on a series of PPI scopes. Superimposed by transparent charts showing maps, weather and wind data, etc., the PP displays are televised to the aircraft.



5—DISTANCE MEASURING/DIRECTION FINDING

5.1 Distance measuring and homing by VHF Rebecca-Eureka	Télémétrie et radioralliement par le système VHF «Rebecca-Eureka»	Telemetría y radioalineación con el sistema VHF «Rebecca-Eureka»	VHF Distanz-Mess- und Zielflug-Verfahren «Rebecca-Eureka»
Eureka (ground responder)	Eureka (répondeur fixe)	Eureka (respondedor fijo)	«Eureka» (Wiederholer am Boden)
Rebecca (airborne interrogator)	Rebecca (interrogateur de bord)	Rebecca (interrogador de a bordo)	«Rebecca» (Bordausrüstung)
Central transmitting/receiving antenna	Antenne centrale d'émission et de réception	Antena central de emisión y de recepción	Zentrale Sende/Empfangsantenne
Double receiving antennas	Antennes doubles de réception	Antenas dobles de recepción	Doppelte Empfangsantennen (an Bord)

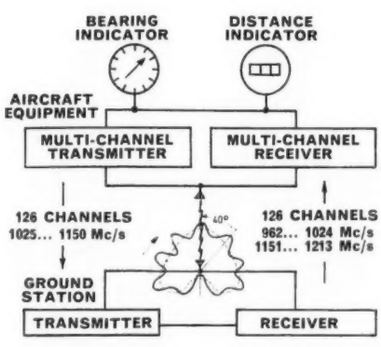
A short-range aid to navigation off airways, used primarily for homing to an airport. An airborne radar station (Rebecca) emits VHF pulses from a central transmitting aerial and these are repeated on a different frequency by a non-directional ground responder (Eureka) located in the vicinity of the airport. The ground reply is received on board the aircraft by two D/F antennas and displayed on an indicator giving distance (R) and approximate relative bearing (β). Range is 50—100 miles dependent on altitude and the Eureka power.



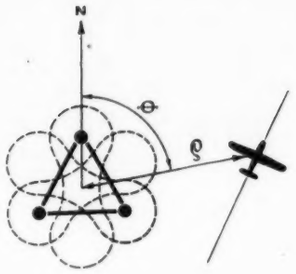
6. DISTANCE MEASURING/ DIRECTIONAL TRANSMISSION SYSTEMS

6.1 Medium-range navigation system TACAN	Système de navigation TACAN pour distances moyennes	Sistema de navegación TACAN para distancias intermedias	Mittelstrecken-Navigationssystem «TACAN»
Polar coordinate system	Système à coordonnées polaires	Sistemas de coordenadas polares	Polarkoordinatensystem
Bearing indicator	Indicateur d'azimut	Indicador de azimut	Azimut-Anzeiger
Distance indicator	Télémètre	Telémetro	Entfernungs-Anzeiger
Coarse bearing	Gisement grossier	Posición aproximada	Grobazimut
Fine bearing	Gisement précis	Posición precisa	Feinazimut

The TACAN ground station employs a rotating beam antenna to transmit continuous signals for bearing reference in the aircraft and, as required, reply signals for distance measuring (polarcoordinate navigation). Each second 3,600 pairs of pulses are transmitted, of which 900 are reserved for reference groups for coarse and fine bearing, while the remaining 2,700 are random in time and include synchronized replies to distance interrogation. The cardioid radiation pattern turns 15 times per second and the aircraft receives an amplitude-modulated series of pulses whose envelope is a sine wave of 15 c/s and whose phase gives coarse bearing information. As the cardioid radiation pattern is divided into nine 40° sectors, the envelope also contains a sine-wave component with a frequency of 135 c/s, whose phase gives fine bearing information. A 1° change in bearing results in a 9° change in the measured phase of the 135 c/s signal. The use of a series of discrete pulses instead of continuous waves enables distance measurement and bearing determination to be carried out on the same frequency, as well as permitting additional ATC information to be communicated by means of the multiplex procedure. This facility is utilized in the TACAN Data Link, a combined navigation and ATC system. The VORTAC system combines VOR equipment with the TACAN distance measuring system; a course line computer which evaluates bearing and range data is designed to enable aircraft to navigate on a track parallel to any radial so as to bypass the ground station.

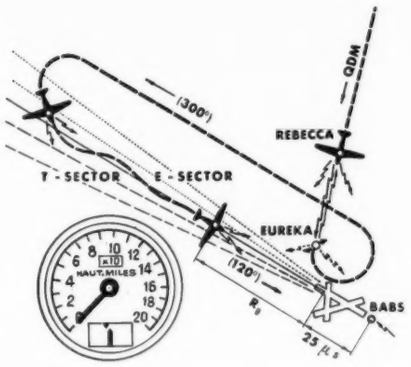


6.2 **LF long-range navigation system NAVARHO**	**Système LF de navigation sur longues distances NAVARHO**	**Sistema de navegación para grandes distancias NAVARHO**	**LF Langstrecken-Navigationssystem «NAVARHO»**
Azimuth meter (Θ)	Cadran des azimuts (Θ)	Cuadrante de azimuts (Θ)	Azimutmesser (Θ)
Distance meter (ϱ)	Compteur de distance (ϱ)	Contador de distancia (ϱ)	Entfernungsmesser (ϱ)
Rho-Theta coordinates	Coordonnées Rho-Thêta	Coordenadas Rho-Theta	Rho-Theta-Koordinaten
Figure 8 radiation patterns	Diagrammes de rayonnement en 8	Diagramas de radiación en 8	Achtförmige Richtdiagramme



A polar coordinate system for high accuracy bearing (± 0.5° to ± 1°) with a range of up to 1,800 n.m., employing a three-transmitter ground station. Continuously transmitted pulse pairs form three figure-eight radiation patterns. In the aircraft the amplitudes of these three signals are compared to define bearing. Distance measurement is accomplished by means of phase comparison of the transmitted signal with a frequency standard integral with the receiving equipment. A computer provides continuous calculation of the Rho-Theta coordinates for the aircraft's position, and at the same time delivers data on distance remaining, deviation from course, etc. Between 30 and 50 ground stations would be required to cover the world, but at the present time only one research station exists at Camden, New York.

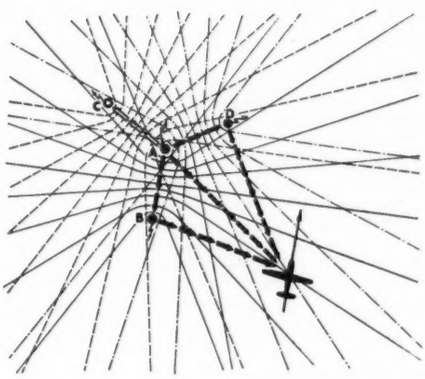
6.3 **VHF blind approach beacon system BABS and Rebecca**	**Système VHF d'approche BABS et Rebecca**	**Sistema VHF de aproximación BABS y Rebecca**	**VHF Blind-Landeverfahren «BABS-Rebecca»**
Directional radar beacon BABS	Répondeur directionnel BABS	Respondedor direccional BABS	Impulswiederholer-Richtbake «BABS»
Short-duration pulses (dots-E) on port side	Impulsions brèves (points-E) à gauche	Impulsos breves (puntos-E) a la izquierda	Kurzimpulse (Punkte; E) auf Backbordseite
Long-duration pulses (dashes-T) on starboard side	Impulsions longues (traits-T) à droite	Impulsos largos (trazos-T) a la derecha	Langimpulse (Striche; T) auf Steuerbordseite
Distance to touch-down point	Distance au point d'atterrissage	Distancia al punto de aterrizaje	Entfernung bis zum Aufsetzpunkt



Aircraft equipped with Rebecca (cf. 5.1) can, after homing on a Eureka beacon, utilize the BABS ground beacon as an approach aid. The pulses transmitted by Rebecca are answered by BABS with dots (E) on the port side of the approach path and dashes (T) on the starboard; incoming signals are displayed on the Rebecca scope as left-right deviations. The CRT time-base is delayed by 25 microseconds to permit the distance to touch-down point (and not to the BABS beacon) to be given.

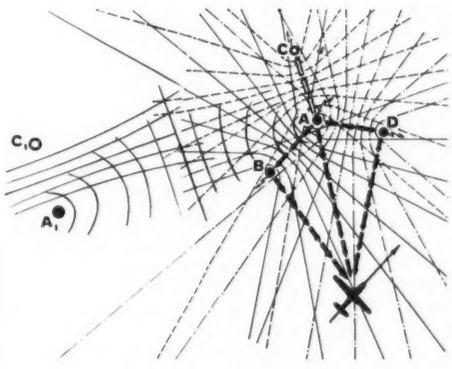
7 — HYPERBOLIC NAVIGATION SYSTEMS

7.1 **Differential distance measuring with pulse modulation**	**Système de mesure différentielle des distances à modulation des impulsions**	**Sistema de medida diferencial de las distancias con modulación de los impulsos**	**Differenz-Entfernungsmessverfahren mit Impulsmodulation**
GEE (VHF) for short-range navigation	Système «GEE» (VHF) de navigation sur courtes distances	Sistema «GEE» (VHF) de navegación para cortas distancias	«GEE» (VHF) für Kurzstreckennavigation
LORAN (MF) for long-range navigation	Système «LORAN» (MF) de navigation sur longues distances	Sistema «LORAN» (MF) de navegación para grandes distancias	«LORAN» (MF) für Langstreckennavigation
Master station (A)	Station maîtresse (A)	Estación maestra (A)	Hauptsender oder Primärstrahler (A)
Slave stations (B, C, D)	Stations asservies (B, C, D)	Estaciones dependientes (B, C, D)	Nebensender oder Sekundärstrahler (B, C, D)



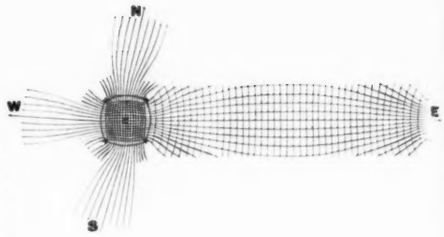
In the GEE and LORAN systems the differences in travel time of pulses emitted by a chain of widely separated but synchronized ground stations are measured in the aircraft receiver, each difference corresponding to a hyperbolic position line (locus of all points having a constant difference in distance from two fixed points). The position of the aircraft is at the intersection of two hyperbolae. There are two types of hyperbolic equipment: STANDARD LORAN system in which slave stations are within the ground wave range of the master station; and SS-LORAN (Skywave Synchronization-LORAN).

7.2 **Differential distance measuring without pulse modulation**	**Système de mesure différentielle des distances sans modulation des impulsions**	**Sistema de medida diferencial de distancias, sin modulación de los impulsos**	**Differenz-Entfernungsmessverfahren ohne Impulsmodulation**
DECCA (LF) for short and medium-range navigation	Système DECCA (LF) de navigation sur les distances courtes et moyennes	Sistema DECCA (LF) de navegación sobre distancias cortas e intermedias	«DECCA» (LF) für Kurz- und Mittelstrecken-navigation
DECTRA (LF) for long-range navigation	Système DECTRA (LF) de navigation sur longues distances	Sistema DECTRA (LF) de navegación a grandes distancias	«DECTRA» (LF) für Langstreckennavigation
DECCA-Lanes	Cheminements DECCA	Encaminamientos DECCA	DECCA-Funkschneisen
DECCA-Ranges	Distances DECCA	Distancias DECCA	DECCA-Entfernungsreferenz



Unlike GEE and LORAN, the DECCA and DECTRA systems function with unmodulated continuous-wave phase-synchronized signals. In the aircraft phase-comparison of each pair of signals from a group of ground stations produces hyperbolae for all points at which phase difference is zero. The DECCA system employs four ground transmitters (a central master station and three synchronized slave stations approx. 110 n.m. distant) and virtually lays three hyperbolic patterns (red, green and purple) over the area; position over a wide area can be determined from the intersection angles of pairs of hyperbolae. By comparison, the DECTRA system employs one master and one slave station at each end of an airway; each pair of stations provides a tracking facility from a stable hyperbolic pattern laid along the track, while the combination of the transmission from one station of each pair provides a ranging facility from a hyperbolic pattern across the track. To overcome the worst possible combination of propagation and reception conditions a second ranging system utilizes the reception of signals from one source only and the divided output of a crystal oscillator. In addition to the indicator instruments (Decometer, Decca range meter, Decca track meter) the Decca Flight Log provides a continuous record of the aircraft's track on a special chart. Dectra stations can be incorporated in Decca chains.

7.3 Radio-Mailles (radio-mesh) navigation system	Système de navigation Radio-Mailles	Sistema de navegación Radio-Mallas	Funkgitter-Navigationssystem «Radio-Mailles»
Mobile isophase lines	Lignes isophases mobiles	Líneas isofasicas móviles	Mobile Isophasenlinien
Tone modulated carrier waves	Ondes porteuses modulées par une fréquence acoustique	Ondas portadoras moduladas por una frecuencia acústica	Tonfrequenz-modulierte Trägerwellen
Short, medium and long-range navigation	Navigation sur distances courtes, moyennes et longues	Navegación sobre distancias cortas, intermedias y grandes	Kurzstrecken-, Mittelstrecken- und Langstreckennavigation
Ground position finding	Détermination des positions	Determinación de posición	Fremdortung
Collision warning	Prévention des collisions	Prevención de colisiones	Kollisionswarnung



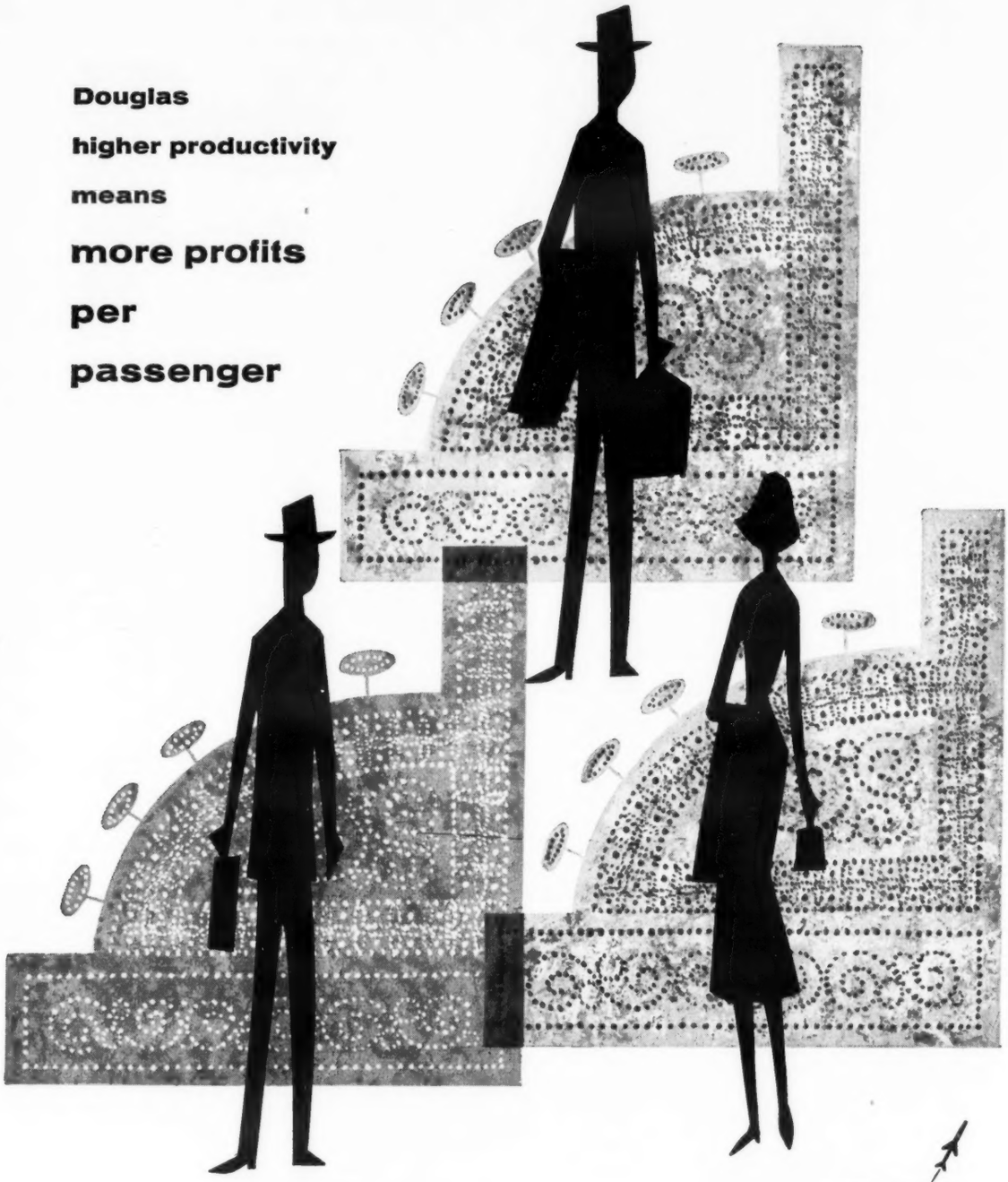
Four ground stations are employed, two transmitting tone modulated signals on frequency p, *and two on a neighbouring frequency* q; *these transmissions produce four mobile isophase lines (the geometrical location of all points at which two radio signals* p *and* q *arrive with the same phase at a given moment), resembling hyperbolae. These isophase lines constantly change position so that they scan the whole area, and in the aircraft the time difference between the passage of two isophase lines is measured. If each time difference along a position line is recorded, the result is two groups of position lines which form networks or meshes varying according to the geometrical arrangement of the ground transmitters. Four transmitters are set up in a rectangular pattern for approach area or short-range navigation; four transmitters arranged in pairs at either end of an airway for medium-range and long-distance navigation. The system functions on any frequencies, and these can be selected for their particular propagation characteristics: LF for long-range, MF for medium-range, and VHF, UHF or SHF for approach areas. By the employment of various auxiliary equipment the system can also be utilized for ground direction finding, selective communication with a given aircraft, and collision warning.*

Some Common Abbreviations

AACS	Airways and Air Communications Service (U.S.A.)	Flugsicherungsdienst der U.S. Wehrmacht	Service des voies aériennes et des télécommunications aéronautiques (Etats-Unis)	Servicio de vías aéreas y telecomunicaciones aeronáuticas (Estados Unidos)
ACC	Air Coordinating Committee (U.S.A.)	Luftfahrtkoordinierungsausschuss der U.S. Regierung	Commission de coordination des questions d'aviation (Etats-Unis)	Comisión de coordinación de asuntos de aviación (Estados Unidos)
ACC	Area Control Centre	Bezirkskontrollzentrale	Centre de contrôle régional	Centro de control regional
ACR	Approach Control Radar	Anflugkontrollradar	Radar de contrôle d'approche	Radar de control de aproximación
ADC	Aerodrome Control	Flugplatzkontrolle	Contrôle d'aérodrome	Control de aeródromo
ADF	Automatic Direction Finder	Automatischer Radiokompass	Radiogoniomètre automatique	Radiogoniómetro automático
AIS	Aeronautical Information Service	Flugsicherungs-Beratungsdienst	Service d'informations aéronautiques	Servicio de informaciones aeronáuticas
AM	Amplitude Modulation	Amplitudenmodulation	Modulation d'amplitude	Modulación de amplitud
APC	Approach Control	Anflugkontrolle	Contrôle d'approche	Control de aproximación
APP	Approach Control (Office)	Anflugkontrolle (Anflugkontrollstelle)	Contrôle d'approche (bureau)	Control de aproximación (oficina)
API	Air Position Indicator	Standortanzeiger	Indicateur de position	Radar indicador de posición
ARI	Airborne (Aircraft) Radio Instrument	Bordfunk(mess)gerät	Instrument radio de bord	Instrumento radio de a bordo
ASMI	Airfield Surface Movement Indicator	Rollbetrieb-Überwachungsradar	Radar indicateur des mouvements de surface sur les aéroports	Radar indicador de los movimientos de superficie de los aeropuertos
ASR	Airport Surveillance Radar	Flughafen-Rundsichtradar	Radar de surveillance sur aéroports	Radar de vigilancia sobre los aeropuertos
ATC	Air Traffic Contro	Luftraumüberwachung	Contrôle de la circulation aérienne	Control de la circulación aérea
ATS	Air Traffic Services	Flugsicherungsdienste	Services de la circulation aérienne	Servicios de la circulación aérea
BABS	Blind Approach Beacon System	Babs-Leitstrahl-Blindlandeverfahren	Système (Babs) d'atterrissage sans visibilité	Sistema (Babs) de aproche sin visibilidad
BCN	Beacon	Funkfeuer, Funkbake, Bake	Radiophare, radiobalise	Radiofaro, radiobaliza
BM	Boundary (inner) Marker	Platz-Einflugzeichen	Radiobalise de délimitation	Radiobaliza de delimitación
BS	Broadcast Station	Rundfunksender	Station de radiodiffusion	Estación de radiodifusión
CAA	Civil Aeronautics Administration (U.S.A.)	U.S. Zivilluftfahrtverwaltung	Administration de l'aviation civile (Etats-Unis)	Administración de la aviación civil (Estados Unidos)
CAATC	CAA Type Certificate	CAA-Zulassung für Funknavigationsgeräte	Certificat d'homologation CAA	Certificado de homologación CAA
CAB	Civil Aeronautics Board (U.S.A.)	Ziviles U.S. Bundesamt für Flugsicherung	Bureau de l'aéronautique civile (Etats-Unis)	Oficina de la aeronáutica civil (Estados Unidos)
CF	Carrier Frequency	Trägerfrequenz	Fréquence porteuse	Frecuencia portadora
COM	Communication	Verbindung, Mitteilung	Télécommunications	Telecomunicación
COM	COMmunications (ICAO division)	Fernmeldewesen (ICAO-Abteilung)	Télécommunications (division de l'OACI)	Telecomunicaciones (división de a OACI)
CON	Consol	Consol (Sonne)	Consol	Consol
CR. D/F	Cathode Ray Direction Finder	Fremdpeilgerät mit Kathodenstrahlröhre	Radiogoniomètre à oscilloscope cathodique	Radiogoniómetro de osciloscopio catódico
CRT (CRO)	Cathode Ray Tube (Oscillograph)	Kathodenstrahlröhre	Tube (oscilloscope) à rayons cathodiques	Tubo (osciloscopio) catódico)
CTA	Control Area	Flugsicherungs-Kontrollbezirk	Région de contrôle	Región de control
CTR	Control Zone	Flugsicherungs-Kontrollzone	Zone de contrôle	Zona de control
CW	a) Carrier Wave	a) Trägerwelle	a) Onde porteuse	a) Onda portadora
	b) Continuous Wave	b) Modulierte ungedämpfte Welle	b) Onde entretenue pure	b) Onda entretenida
D/F	Direction Finder	Peilgerät	Radiogoniomètre	Radiogoniómetro
DF/CS	Direction Finding Control Station	Fremdpeil-Kontrollstelle	Station de contrôle radiogoniométrique	Estación de control radiogoniométrico
DME	Distance Measuring Equipment	Entfernungsmessgerät	Télémètre radar	Telémetro radar
EHF	Extremely High Frequency	Extrem hohe Frequenz (Millimeterwellen)	Fréquences extrêmement hautes (ondes millimétriques)	Frecuencias extremadamente altas (ondas milimétricas)
F	Frequency	Frequenz	Fréquence	Frecuencia
FIDO	Fog, Intensive Dispersal Of	Entnebelungsanlage auf Flugplätzen	Système de dissipation du brouillard	Sistema de disipación de niebla
FIC	Flight Information Centre	Flugsicherungs-Informationszentrale	Centre d'information de vol	Centro de información de vuelo
FIR	Flight Information Region	Flugsicherungs-Informationsgebiet	Région d'information de vol	Región de información de vuelo
FIS	Flight Information Service	Flugsicherungs-Informationsdienst	Service d'information de vol	Servicio de información de vuelo
FM	a) Fan Marker	a) Fächer-Markierungsbake	a) Radiobalise en éventail	a) Radiobaliza en abanico
	b) Frequency Modulation	b) Frequenzmodulation	b) Modulation de fréquence	b) Modulación de frecuencia
GCA	Ground Controlled Approach	Vom Boden geleitete Radar-Blindlandung	Approche (dirigée) du sol	Aproche dirigido desde tierra
GP	Glide Path (transmitter)	Gleitweg (bake)	Emetteur de trajectoire de descente	Emisor de la trayectoria de descenso
GPI	Ground Position Indicator	Standortanzeiger	Radar indicateur de position	Radar indicador del punto

GPR	General Purpose Radar	Allzweckradar	Radar d'usage général	Radar de uso general
G/S	Ground Station	Bodenstelle	Station terrestre	Estación terrestre
HDF (HFDF)	High Frequency Direction Finder	HF-Fremdpeilstation	Radiogoniomètre haute fréquence	Radiogoniómetro alta frecuencia
HF	High Frequency	Hochfrequenz	Hautes fréquences	Altas frecuencias
HVDF	High and Very High Frequency Direction Finder	HF/VHF-Fremdpeilstation	Radiogoniomètre HF/VHF	Radiogoniómetro HF/VHF
IFR	Instrument Flight Rules	Blindflug-Regeln (vorgeschrieben)	Règles du vol aux instruments	Reglas del vuelo con instrumentos
ILS	Instrument Landing System	Instrumenten-Landeverfahren	Système d'atterrissage aux instruments	Sistema de aterrizaje con instrumentos
IM	Inner (boundary) Marker	Platz-Einflugzeichen	Radiobalise intérieure (BM)	Radiobaliza interior (BM)
IR	Interrogator-Responder	Frage/Antwort-Gerät (Radar)	Interrogateur-répondeur	Interrogador-respondedor
L	Compass Locator	Rundstrahlsender für Navigation mittels Radiokompass	Phare de radiocompas	Faro de radiocompás
LAN	LANding aid	Blindlandeanlage	Auxiliaire d'atterrissage	Auxiliar de aterrizaje
LF	Low Frequency	Niederfrequenz (Kilometerwellen)	Basses fréquences	Bajas frecuencias
LFDF	Low Frequency Direction Finder	LF-Fremdpeilstation	Radiogoniomètre basse fréquence	Radiogoniómetro baja frecuencia
LOC	LOCalizer	Anflugbake	Radiophare d'alignement par rapport à la piste	Radiofaro de alineación con relación a la pista
LP	Loop	Rahmen; Peilrahmen	Cadre (de goniomètre)	Cuadro (de goniómetro)
M	Marker beacon	Markierungsbake	Radiobalise	Radiobaliza
MCW	Modulated Continuous Wave	Modulierte ungedämpfte Welle	Onde entretenue modulée	Onda entretenida modulada
MDF (MFDF)	Medium Frequency Direction Finder	MF-Fremdpeilstation	Radiogoniomètre moyenne fréquence	Radiogoniómetro de mediana frecuencia
MET	METeorological broadcasts	Wetterfunk	Emissions météorologiques	Emisiones meteorológicas
MF	Medium Frequency	Mittelfrequenz (Hektometerwellen)	Fréquences moyennes	Frecuencias medias
MHDF	Medium and High Frequency Direction Finder	MF/HF-Fremdpeilstation	Radiogoniomètre MF/HF	Radiogoniómetro MF/HF
MHVDF	Medium, High, and Very High Frequency Direction Finder	MF/HF/VHF-Fremdpeilstation	Radiogoniomètre MF/HF/VHF	Radiogoniómetro MF/HF/VHF
MLS	Microwave Landing System	Mikrowellen-Blindlandesystem	Système d'atterrissage à micro-ondes	Sistema de aterrizaje con micro-ondas
MM	Middle Marker	Haupt-Einflugzeichen	Radiobalise médiane	Radiobaliza mediana
MTI	Moving Target Indicator	Radar-Sichtgerät mit Festzeichen-Ausblendung	Dispositif d'élimination des échos fixes	Dispositivo de eliminación de ecos fijos
MVDF	Medium and Very High Frequency Direction Finder	MF/VHF-Fremdpeilstation	Radiogoniomètre MF/VHF	Radiogoniómetro MF/VHF
N (NAV)	Navigational Aid	Navigationshilfe	Auxiliaire de navigation	Auxiliar de navegación
NDB	Non-Directional (radio) Beacon	Ungerichtetes Funkfeuer	Radiophare non directionnel	Radiofaro no direccional
OBI	Omni-Bearing Indicator	Automatischer Azimutanzeiger	Indicateur automatique d'azimut	Indicador automático de azimut
OM	Outer Marker	Vor-Einflugzeichen	Radiobalise extérieure	Radiobaliza exterior
PAM	Pulse-Amplitude Modulation	Pulsamplitudenmodulation	Modulation d'impulsions en amplitude	Modulación por impulsos modulados en amplitud
PAR	Precision Approach Radar	Präzisions-Anflugradar	Radar d'approche de précision	Radar de aproche de precisión
PCM	Pulse-Code Modulation	Pulscodemodulation	Modulation par impulsions codées	Modulación por impulsos cifrados
PDM (PLM; PWM)	Pulse-Duration (Length; Width) Modulation	Pulsdauer- (längen; breiten)-modulation	Modulation par la durée (la longueur, la largeur) des impulsions	Modulación por duración (longitud, anchura) de los impulsos
PE	Permanent Echo	Festecho (Radar)	Echo fixe	Eco fijo
PF	Pulse Frequency	Impulsfrequenz	Fréquence d'impulsion	Frecuencia de impulso
PFM	Pulse-Frequency Modulation	Pulsfrequenzmodulation	Modulation d'impulsions en fréquence	Modulación de frecuencia por impulsos
PM	Phase Modulation	Phasenmodulation	Modulation de phase	Modulación de fase
PMW	Pulse Modulated Wave	Pulsmodulierte Welle	Onde modulée par impulsions	Onda modulada por impulsos
PNM	Pulse-Number Modulation	Pulszahlmodulation	Modulation d'impulsions en nombre	Modulación por impulsos en número
PPI	Plan Position Indicator	Radarsichtgerät mit drehender Zeitachse (Polarkoordinatenröhre)	Indicateur de gisement en projection	Indicador de posición en proyección
PPM	Pulse-Phase (Position) Modulation	Pulsphasen(lagen)modulation	Modulation d'impulsions en phase (en position)	Modulación por impulsos de variación de tiempo (de posición)
PPPI	Precision (Projection) PPI	Präzisions- (Projektions-) PPI	PPI de précision	PPI de precisión
PRF	Pulse-Recurrence Frequency	Impulsfolgefrequenz	Fréquence de répétition des impulsions	Frecuencia de impulsos
R	Radio	Funk	Radio	Radio
RAC	Rules of the Air and Air Traffic Control	Luftverkehrsregeln und Regeln für die Flugsicherungskontrolle	Règles de la circulation aérienne et du contrôle de la circulation aérienne	Reglas de la circulación aérea y de control de la circulación aérea
RADAR	Radio Detection and Ranging	Radar; Funkmesstechnik	Radar = procédé radioélectrique de détection et de mesure de distances	Radar = procedimiento radioeléctrico de detección de distancias
RBN	Radio Beacon	Funkbake; Funkfeuer	Radiophare, radiobalise	Radiofaro, radiobaliza
RBS	Radio Beacon Station	Funkbake; Funkfeuer	Station de balisage radioélectrique	Estación de balizado radioeléctrico
RF	Radio Frequency	Funkfrequenz; Hochfrequenz	Haute fréquence	Alta frecuencia
RNG	Radio Range	Leitstrahlbaken; Kursfunkfeuer	Radiophare d'alignement	Radiofaro de alineación
RSP	Responder Beacon	Wiederholerbake	Radiophare répondeur	Radiofaro respondedor
R/T	Radio Telephony	Funksprechverkehr	Radiotéléphonie	Radiotelefonía
RT	Receiver and Transmitter	Empfänger/Sender	Emetteur - récepteur	Emisor - receptor
RTCA	Radio Technical Commission for Aeronautics (U.S.A.)	Amerikanischer funktechnischer Ausschuss für Luftfahrt	Commission technique de radio aéronautique (Etats-Unis)	Comisión técnica de radioaeronáutica (Estados Unidos)
SBA	Standard Beam Approach system	SBA-Blindlande-Funkfeuersystem	Système normalisé d'approche à faisceaux	Sistema normalizado de aproximación por haces
SHF	Super High Frequency	Superhohe Frequenz (Zentimeterwellen)	Fréquences supérieures	Frecuencias supraaltas
SRE	Surveillance (Search) Radar Element	Radar-Rundsichtgerät	Radar de surveillance	Radar de vigilancia
SSB	Single Sideband	Einseitenband	Bande latérale unique	Banda lateral única
TEL(ECOM)	TELECOMmunications	Fernmeldeverkehr	Télécommunications	Telecomunicación
TP	Teleprinter	Fernschreiber	Télétype, téléimprimeur	Teletipo, teleimpresor
TR	Transmitter	Sender	Emetteur	Emisor
TRANSCEIVER	Transmitter - Receiver	Sender/Empfänger	Emetteur - récepteur	Emisor - receptor
TSP	Transponder	Antwortsender	Répondeur	Respondedor
TV	Television	Fernsehen	Télévision	Televisión
TWR	Tower (Aerodrome Control)	Kontrollturm (Flughafen-Kontrolle	Tour de contrôle	Torre de control
UHF	Ultra High Frequency	Ultrahohe Frequenz (Dezimeterwellen)	Ultra-hautes fréquences	Frecuencias ultraaltas
VAR	Visual-Aural (four course radio) Range	Optisch/akustisch anzeigendes Vierkurs-Leitstrahlbakensystem	Radiophare d'alignement à repérage visuel et acoustique	Radiofaro de alineación de marcación visual o acústica
V(HF)DF	Very High Frequency Direction Finder	VHF-Fremdpeilstation	Radiogoniomètre VHF	Radiogoniómetro VHF
VFR	Visual Flight Rules	Sichtflugregeln	Règles du vol à vue	Reglas del vuelo a vista
VHF	Very High Frequency	Sehr hohe Frequenz (Meterwellen)	Très hautes fréquences	Muy altas frecuencias
VLF	Very Low Frequency	Sehr niedrige Frequenz (Myriameterwellen)	Très basses fréquences	Muy bajas frecuencias
VOR	VHF Omni Range	VHF Drehfunkfeuer	VOR, radiophare VHF omnidirectionnel	VOR, radiofaro VHF omnidireccional
WS	Wireless Set	Funkgerät	Poste radio	Puesto radio
W/T	Wireless Telegraphy	Tastfunk	T.S.F., télégraphie sans fil	T.S.F., telegrafía sin hilos
Z	Greenwich Mean Time	Greenwicher Normalzeit	Heure du méridien de Greenwich	Hora del meridiano Greenwich
ZM	Zero-Marker beacon	Z-Markierungsbake	Radioborne Z	Radioborne Z

Douglas
higher productivity
means
more profits
per
passenger



High cruising speed under low cost operating conditions is only one of the factors that make Douglas transports the most productive in aviation.

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Higher productivity is another of the reasons so many airlines depend on Douglas equipment.

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The Intercontinental version will be operating on the services of British Overseas Airways Corporation by 1959. It will carry its capacity payload, about 60 passengers with first-class seating or, if desired, up to 76 passengers with tourist-class seating, on stages up to about 3,000 miles.

The Continental version will be operating on the services of British European Airways Corporation by 1960. This version will carry its capacity payload, about 84 first-class passengers or up to 99 tourist-class passengers, on stages as short as 300-500 miles, and up to about 2,000 miles.

Both versions of the new Comet are specifically designed and developed to operate and pay their way on routes of moderate traffic density and from airports of moderate size.

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D E H A V I L L A N D

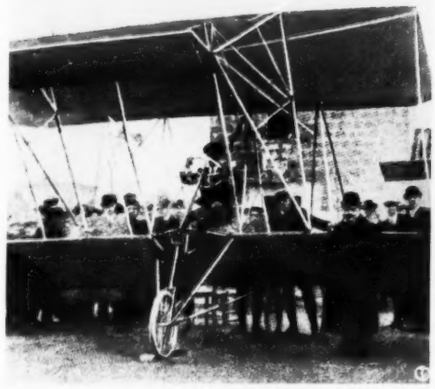
Costruzioni Aeronautiche Giovanni Agusta

50 years activities

One of the most striking success stories of Italy's postwar aircraft industry is that of Costruzioni Aeronautiche Giovanni Agusta, which in only four years has built up a particularly active production line. Since 1954 the company has built more than 300 helicopters, some 80 percent of which have been exported, according to the latest figures available. The output figure is expected to reach 400 before 1958 is over. Many people, both in Italy and abroad, have shown surprise at these results, as if there were something accidental about them. In truth, they have been achieved by one of the oldest aircraft manufacturers in Italy . . . if not in the world, as it celebrates its fiftieth anniversary this year.

Its founder, Giovanni Agusta, started in the business in 1907, when he built the first aeroplane of his own design. This was a biplane, with two stabilizers, one forward and the other aft, which Agusta himself set out to test fly in 1908. Tests, modifications and two rebuildings necessitated by accidents lasted until 1911. In that year Giovanni Agusta designed a parachute big enough to float his aeroplane back to the ground in the event of engine failure. This parachute was housed in a large tube and was opened by means of a ball of lead which the pilot threw overboard when the engine failure occurred.

Needless to say, all this work was done on a purely private basis, without any assistance from the authorities; to solve his problems (and there is no need to dwell on the many unknowns confronting these early pioneers) Giovanni Agusta could count only on his own resources and, above all, his own enthusiasm. On Italy's entry into World War I Agusta was one of the earliest members of the first air battalion formed at Cascina Malpensa, along with Gianni Caproni, Emilio Pensuti and the other pioneers who built the celebrated Italian aeroplanes of the 1915-1918 war.



Pioneer Giovanni Agusta in 1908, at the controls of the biplane of his own design.

After the lull which followed the war, Giovanni Agusta was again the first to return to aircraft production. Costruzioni Aeronautiche Agusta was founded at Tripoli in 1920, moved to Benghazi in 1922 and finally, from 1923 onwards, settled at Cascina Costa, where it still has its plant. Its first task was to rebuild, under contract, the few Caproni Ca.3s which had survived the war and the subsequent run-down.

Meanwhile Agusta had designed and built the Agusta-3, a light aircraft with large wing area and a 15 h.p. Anzoni engine. This small machine was the first Italian civil sports aircraft. Its further development was rudely interrupted by the untimely death of Giovanni Agusta on November 27th, 1927, at the age of only 48, and at the peak of his career. He left a wife and four young sons.

It looked as if the tremendous sacrifices made by this enthusiastic pioneer and his whole life's work had been in vain. But this prospect was averted thanks to the devotion and perseverance of Giuseppina, Giovanni's widow, and thanks no less to the loyalty of department chiefs and workers alike. Domenico, the oldest of the sons, then only 21, took over the post of manager; he had already had some experience of aviation, as his father had agreed to his joining the Air Force at the age of 18. The whole staff rallied round and acted as mentors to their young manager and his even younger brothers Vincenzo (who died in May 1958), Mario and Corrado. Under the guidance of Giuseppina Agusta, its President, the company prospered and expanded, built and rebuilt in quantity, designed its own aircraft and, in 1936, brought out a single-seat touring monoplane, the Agusta-6.

Under the Government plan for distributing work among the various Italian manufacturers, the Agusta company was made responsible for production of the Ro.41 fighter and trainer biplane and, in collaboration with Engineer Parona, for redesigning the Breda 88 into a dive bomber.

Then came World War II, and Agusta was instructed to set up a branch in Albania; this was known as Costruzioni Aeronautiche Giovanni Agusta—Officine di Tirana and devoted its resources to repairing aircraft and producing spares.

The first production Agusta-Bell 47-G helicopter came off the assembly line at Cascina Costa in 1954.

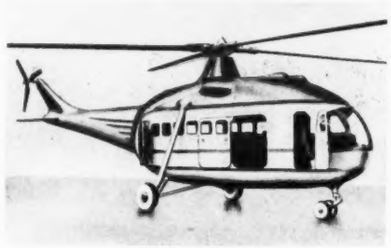
Agusta-Zappata AZ.8-L four-engine military transport (with Alvis "Leonides" engines each of 540 h.p. take-off rating) at Cascina Costa airfield, adjoining Milan-Malpensa Airport.

Time went on. Soon there was the Italian armistice, the German occupation, widespread destruction and the end of the war. The company found itself obliged to turn to other activities, and a new company, M. V. Agusta, independent of Costruzioni Aeronautiche, was founded at Verghera for the production of motor cycles.

The manufacture of aircraft was not resumed until 1950, when a small batch of Ro.41 trainers was built and a number of projects prepared, including the AP.111 of which several prototypes were made.

Unlike those who were convinced that the Italian aircraft industry had lost all chance of asserting itself again, at least for several decades, the Agusta company, backed by the confidence and tenacity of its President and by its long tradition, immediately embarked on an energetic campaign to reconstruct its installations and, above all, to build up an efficient design office. After several attempts, these efforts finally culminated in the creation of a design office under one of Italy's foremost designers, Engineer Filippo Zappata, assisted by his best collaborators.

With the signing of a licence agreement with Bell Aircraft Corp. in 1952, a new field of activity opened up, the quantity production of helicopters. The first machine, the Agusta-Bell 47-G, made its first flight in May 1954, but it was not until January 1955 that production really got under way. More than 300 helicopters of the 47-G (200 h.p. engine), 47-G2 (260 h.p. engine) and 47-J (4 to 5 seats) series have been produced.



Technical data for
the AGUSTA Z-101 D helicopter

Total engine power 2,250 h.p.,
delivered by three "Turmo IIIs" of 750 h.p. each

Weight empty	10,000 lb.
Useful load	7,150 lb.
Max. speed	135 knots
Cruising speed	115 knots
Service ceiling, oblique flight	18,000 ft.
Service ceiling, vertical flight, with ground effect	10,600 ft.

Agusta-Bell helicopters have been sold to practically all countries in Europe and the Mediterranean area, a tribute to the high standard of their manufacture.

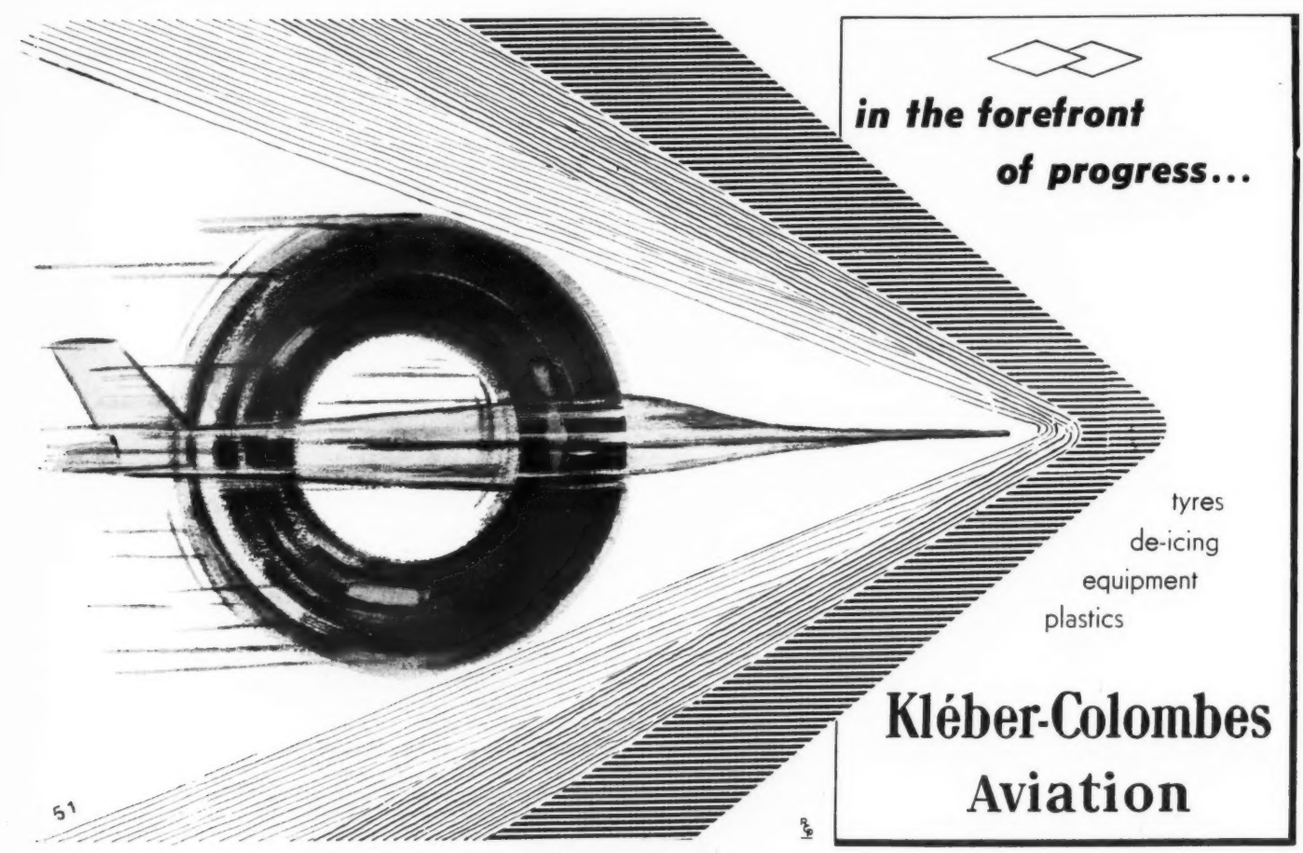
Two new helicopter models are being built. The prototype of the Agusta-Bell-102, fitted with one P & W 600 h.p. engine and anti-torque rotor, is scheduled to make its first flight during the summer of 1958. An important feature of this machine is its particularly modest initial and operating costs. It is equipped to carry 8 or 9 persons, plus the crew, at a speed of 100 knots, and its endurance is more than 3 hours.

Another prototype under development, for the Italian Air Force, is the Agusta-Zappata-101D. This is a three-turbine helicopter capable of carrying 18 to 27 troops.

Its activities in the helicopter field, extending over the whole range up to heavy models, have not prevented Agusta from continuing work on conventional fixed-wing aircraft. Among the projects prepared since the war (including a particularly interesting high-speed, high-capacity aircraft with two turboprops), the Air Force has selected the AZ.8-L for production. This is a four-engine military transport powered by 540 h.p. Alvis *Leonides* engines and capable of carrying 26 passengers at a cruising speed of 185 knots at 10,000 ft.; its maximum speed is 230 knots. It has been flying since April this year and is designed to combine maximum safety with economical operation, good range and flexibility.

On its 50th anniversary Costruzioni Aeronautiche Giovanni Agusta is thus still highly active: three helicopter models in production, two rotary-wing prototypes being built or developed and a four-engine transport undergoing certification tests.

Today Domenico Agusta, President and Managing Director, is as old as his company, as he was born in the year when his father Giovanni was flying his first aeroplane.



Automation

Electronic Data Processing at Swissair

Overall view of Swissair's IBM 650 system: In the centre is the IBM 650 computer, which is connected via the IBM 655 control and power supply unit (rear left) with the input and output equipment. Front right, the IBM 533 card-reading and punching equipment, which can read 12,000 punched cards per hour and pass the data to the computer. Front left, an IBM 407 tabulating machine, also connected with the whole system; it not only reads punched cards but also records in writing the results obtained from the computer. Behind the tabulating machine is the IBM 537 reading and punching equipment.

With the tremendous upsurge in civil air traffic in the early post-war years, the airlines found themselves faced with the problem not only of re-equipping with modern aircraft, but also of re-organizing administrative systems. Among other carriers, Swissair quickly realized that it would no longer be possible to cope with the company's administrative and financial business with existing bookkeeping machines. In 1947, therefore, it installed the first punched card machines which during the subsequent years were used for a growing volume of bookkeeping tasks, such as traffic and equipment statistics, costing checks on stocks, the calculation of wages and salaries, and cost accounting. Increasing work volume necessitated constant additions to the punched card system—valued at 1,100,000 Swiss francs—and in 1956 the company installed an electronic computer. In view of the high capital outlay, Swissair has opted in recent years for the renting system in preference to outright purchase, a decision which greatly facilitated the change-over to the present electronic data processing installation.

By 1954 the volume of accounting work had reached a level where such tasks as the detailed balancing of passenger and freight volumes sold and flown could no longer be handled either satisfactorily or economically by a conventional punched card system.

Passenger traffic, which in 1947 had reached a total value of 20,000,000 francs, had increased five years later to 51,000,000 francs, and by 1957 stood at 192,000,000 francs.

Obviously it had again become necessary to look around for other methods of data processing. A survey of available equipment suggested two possible courses of action: either the existing system could be extended by the addition of more modern equipment, or a completely new electronic data processing system could be installed. Swissair decided on the latter course, which had the added advantage of offering a long-term reserve capacity to cope with future demands. Further detailed study led to the conclusion, at the end of 1956, of a renting agreement with International Business Machines for the installation of a Type 650 Electronic Data Processing System and its associated modern punched card system.

Thanks to detailed preparatory work and a careful selection and training of operating staff, Swissair was able to make the transfer to the new system in a bare 12 months. Every accounting process had to be thoroughly checked, and considerable organizational changes had to be made within the company, based on an accurate assessment of the effects of automation and the technical capabilities of the new equipment.

For these conversion tasks Swissair employed a team of organizers and programme writers from its own staff and two IBM experts, who by the end of last year had worked out 26 problems involving a total of some 22,000 programme steps. Suitable Swissair personnel were selected on the basis of reliable psycho-technical tests; the following requirements had to be met:

- operating experience and knowledge of the punched card organization,
- ability to grasp inter-related functions, formulate them clearly and think them through to their logical conclusion,
- adaptability to a milieu of very abstract work over lengthy periods,
- accuracy even in small details.

Before the final decision was taken on the make and type of equipment to be utilized, the responsible chief and his closest collaborators took a series of three-to-six-week courses on various types of machine with leading manufacturers in New York, Paris and Frankfurt. The whole team was also given special training in algebra and arithmetic (to brush up and supplement their existing knowledge) and organizational theory (to ensure a uniform approach to problems), took courses on various machines and their circuitry and finally attended a three-week programming course on the equipment selected.

By the beginning of December 1957 all the equipment had been installed and was ready to begin work. Test runs were then made, and normal working began with the new year.

Comparative costs of the new equipment are:

	Annual rent, including maintenance	Outright purchase
Punched card equipment . .	106,000 francs	539,000 francs
EDP equipment	336,000 francs	1,627,000 francs
Total	442,000 francs	2,166,000 francs

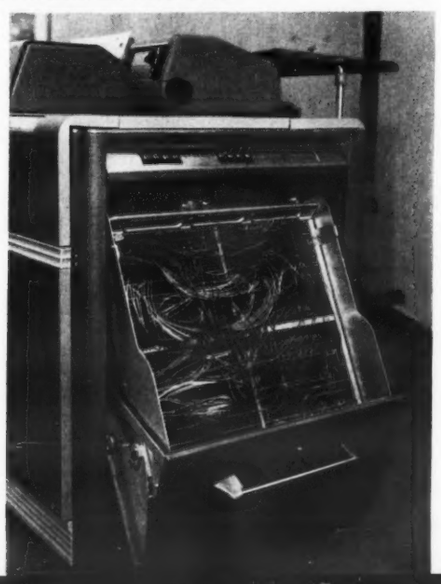
The Swissair management is convinced that from 1959 onwards the saving in administrative costs achieved through use of the electronic computer will more than balance the extra cost of the new equipment; rental charges for the old system will be eliminated, and there will be a saving in man-hours, despite increased output.

•

Among the most important tasks which Swissair's IBM 650 has been performing since January 1958 are the following:

- Ticket and baggage accounting (sales, utilization, balances, statistics),

IBM 407 tabulating machine: With its 120 type drums, it can write 9,000 lines per hour, i.e., read and record the contents of 9,000 punched cards. It can also add, subtract and compare data, or punch the results in special cards. Programming i.e., the issue of instructions to the tabulating machine, is done via cables and a switchboard.



Swissair's IBM 650 Magnetic Drum Computer

The IBM 650 Electronic Data Processing System in service with Swissair, and manufactured by International Business Machines Corporation, consists of the following units:

— IBM 650 computer unit;

— IBM 655 power supply and control unit;

— IBM 533, IBM 537 input and output units (for punching and reading cards) and IBM 407 tabulating machine.

The **IBM 650 computer** contains a magnetic drum which rotates at 12,500 r.p.m. It stores programme instructions, factors, results and tables on 2,000 ten-digit storage positions arranged on the drum surface on 40 adjacent bands. The 2,000 storage positions are numbered consecutively from 0000 to 1999, enabling each position to be selected individually. Mean time taken to tap a memory position is 2.4 micro-seconds, and the stored information can be tapped an unlimited number of times. The drum also contains so-called buffer stores for each input and output unit. Regardless of the electronic computing operation in progress, these buffers take up the factors from the next card on the input side, or pass on the results of the preceding computation on the output side for punching or recording, so that input and output are superimposed in time on the actual programme.

Before the beginning of work on a problem, the programme instructions are entered on the storage drum with the aid of punched cards. Each instruction consists of 10 digits, which are divided into three groups with differing meanings. For example, the two-digit operation code determines what the machine shall do; the four-digit data code indicates the storage position on which the required values are to be found or stored; and the four-digit instruction code shows from which storage position on the drum the next instruction must be read.

The machine is capable of automatically altering the sequence of programme instructions as circumstances require, i.e., it makes logical decisions.

All computing processes and logical decisions are carried out in the computer unit. In multiplication processes, two ten-digit factors can be multiplied into a twenty-digit product. In division processes a twenty-digit dividend can be divided by a ten-digit divisor and produce a ten-digit quotient.

With optimum programming the machine can perform the following number of operations per second:

— 1,300 additions or subtractions

— 83 multiplications

— 61 divisions

— 2,300 logical decisions

The computer unit includes a desk with signal lamps and switches, on which the progress of work can be followed and, if necessary, manual control can take place.

The **IBM 655 power supply and control unit** forms the connecting link between the computer unit and the input and output equipment. It is designed to transfer and translate the decimal figures from the input and output equipment into the internal code for the computer unit, and also supplies the other equipment with the required DC current.

The **IBM 533 card-reading and punching unit** has two separate card feed systems. In the first system the computing factors and other data are read off from punched cards, at a speed of up to 200 cards per minute. In the second, the results obtained from the computer unit are punched into cards (up to 100 cards per minute). Both systems are controlled by the computer.

The **IBM 537 card-reading and punching unit** has one card feed system, in which the factors are taken from punched cards and the results of computations are punched back into the same cards. Up to 155 cards can be handled per minute.

The **IBM 407 tabulating machine** also feeds factors from cards into the computer unit, and records results or other data from the computer on printed forms of any kind. The recording mechanism consists of 120 adjacent type drums, each of which contains 26 letters, 10 figures and 11 symbols. It can record up to 9,000 lines per hour.

Thus Swissair's Electronic Data Processing System includes three units capable of reading cards, two capable of punching results and data into cards and a tabulating machine to record the results on paper.

Each step in any process is automatically checked by the machine. For example, it automatically checks whether all punchings in the cards have been correctly read and whether all the results have been punched. All arithmetical operations, the transfer of data and the selection of the correct factors are completely and automatically checked.

Today more than 800 EDP Systems of the IBM 650 type are in use, including more than 40 in Europe.

— Freight accounting (sales, utilization, balances, statistics),

— Pool accounting (for flight stages operated in conjunction with other carriers),

— Ticket and freight tariff calculating,

— Traffic and operating statistics,

— Wages and salaries calculations,

— Equipment accounting (stores accounting, costs and statistics),

— Cost accounting (purchasing, costing, budget control, etc.).

IBM 650 magnetic drum computer: Lower right, hidden by the recording and reading heads, is the magnetic drum which can store 2,000 ten-digit expressions on its surface. For recording or reading it is rotated at 12,500 r.p.m. under the recording and reading heads.

The following fields are currently being studied for inclusion in the 1959 work programme :

— Flight reports (crew statistics, costing, crew employment, aircraft and engine statistics, ground organization costing),

— Further development of equipment accounting,

— Flight programmes (accounting and budgeting),

— Change-over to punched card financial book-keeping,

— Various calculation and technical problems.

Swissair is also studying the possibility of including other subjects which are suitable for handling by electronic equipment with large memory drums, such as :

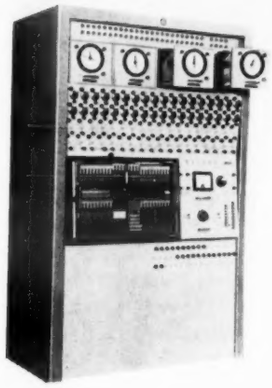
— Seat reservations,

— Servicing and overhaul programmes,

— Aircraft operation and flight preparation, etc.

The exact value of Swissair's electronic data processing equipment in practice will depend on the extent to which the many different problems to be handled can be coordinated and integrated along the simplest possible lines.

Telecommu-

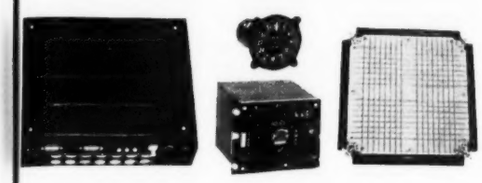


● **Mid-Century Instrumatic Corporation :** The company's new MC-5800 analogue computer, pictured here, differs from older models both in design and expandability. The central equipment is the MC-5800 with 48 operational amplifiers, 8 relay amplifiers, 24 free diodes, 72 scale factor potentiometers, 4 precision servos, 2 servo multipliers, 2 servo resolvers and a removable problem patch board.

● **Radio Corporation of America** has developed a new weather avoidance radar, designated AVQ-50, designed specifically to meet the requirements of transport aircraft confronted with weight, space and power restrictions and to provide much-needed information concerning en route weather conditions. The equipment is equally suitable for installation in small twin-engine aircraft and large transports. Functioning in the X-band the antenna scans an 80° sector ahead of the aircraft 85 times per minute with ranges up to 80 nautical miles. Interpretation of weather targets on the indicator is simplified by the use of iso-echo Contour circuitry which darkens the storm areas containing heavy precipitation and turbulence. The AVQ-50 can also be used for terrain mapping, and by tilting the antenna downwards coastlines, islands, rivers and lakes are sharply outlined on the scope, thus providing a cross check on the position of the aircraft as a navigational aid. Three antenna types are available with 12-inch, 15-inch and 18-inch dish sizes ; pencil beam width with the 12-inch reflector is 7°. The antenna may be tilted at an angle of 10° up or down from the cockpit. Two different indicators are available, either 3-inch or 5-inch display, and operating range may be switched to either 20 or 80 nautical miles. Total weight of the transmitter, receiver, auxiliary equipment, antenna and indicators is approximately 50 lb. Operating frequency 9,375 ± 40 Mc/s ; power output 40 kW ; pulse width 1.8 micro-seconds ; temperatures —40° C to +55° C ; altitude 16,000 ft. unpressurized ; power requirements 500 VA (115 V, 500 c.p.s.). The pictures show the AVQ-50 antenna, transmitter/receiver and auxiliary equipment installed in a fuselage nose, and employed as a helicopter navigational aid.

nications and Electronics

● The **Radio-Air** sub-miniature ADF equipment consists of an extremely flat, fixed ferrite loop antenna (Aérien), the receiver (Récepteur), the control unit (Boite de commande) and the indicator (Indicateur) and weighs only 12.59 lb., or 14.73 lb. with 6-channel frequency pre-selector. Frequency range 200 to 800 kc/s with constant frequency reading ; accuracy of frequency reading 1 % ; for reception of A1, A2 and A3 transmissions ; accuracy ± 2° with an electrical field strength of 50 microvolts/m ; absolute sensitivity defined by a permissible error of ± 10° for a field of less than 15 microvolts/m ; for 27V systems (approx. 2.2 amp) ; reliable operation at altitudes up to 50,000 ft. and at temperaures between —40°C and +70°C.



● **Max Egon Becker,** Flugfunkwerk, Baden-Baden, exhibited at the Hanover Trade Fair the AR 24 VHF airborne radio with built-in intercommunications system, for sports and touring aircraft applications. Characteristics : transmitter/receiver unit for installation in instrument panels (6 ½" × 3" × 8 ¼" ; 5.7 lb.) ; power supply and amplifier unit for installation in a common rack (7½" × 6 7/8" × 10¼" ; 15.4 lb.) ; maximum 24 crystal-controlled transmittingchan nels in the frequency range 118 to 132 Mc/s with 100 kc/s separation ; receiver frequency range 108-118 Mc/s (navigation) and 118-132 Mc/s (voice) ; power consumption 2.6 amps at 12 volts for receiver standby, and 3.8 amps for reception and 6.5 amps for transmission.

● **Marconi Instruments Ltd.** is producing the (illustrated) TF 801C AM signal generator, the latest addition to the company's range. Outstanding features include : frequency cover of 10 to 500 Mc/s with 0.5 % tuning accuracy ; disc-seal triode oscillator and tuned amplifier ; automatic level control ; carrier level continuously variable from 0.1 μV to 0.5 V ; 1,000 c/s internal sinewave a.m. (modulation depth at least 30 %) as well as external sinewave and pulse modulation application (30 c/s to 30 kc/s ; pulse repetition frequency up to at least 50 kc/s). A switch permits the cutting out of a resistor in series with the anode of the oscillator tube, to yield a max. 1 volt modulated or 2 volt unmodulated output. Marconi is also producing the model TF 801B/3/S, a specially military styled version with rugged tropicalized construction.

● **Telefunken GmbH** has installed in Schleswig the first weather radar to be employed by the West German Meteorological Service. The Decca Type 41 equipment now installed will permit more accurate weather observation and forecasting than was possible with the existing observation methods. Precipitation areas and directions of movement over North Germany and Denmark, and the North Sea and Baltic regions can be immediately covered and displayed for ranges of up to 125 miles. Heavy rain areas with very high cloud formation can be observed up to much greater ranges. The equipment has switching possibilities for selection of ranges of 10, 45, 90, 180, 270, 450 kms for observation.

● **Sylvania Radar Altimeter :** The development of a radar altimeter (Model AN/APN-117) for low altitudes, designed especially for use in helicopters, has been announced by the U.S. Navy. At the same time Sylvania Electric Products Incorporated, who designed and produced the altimeter, has revealed that the equipment is available for military and commercial use. Measuring range : 0 to 1,000 ft.

● **C. Lorenz AG :** An interesting combination of office and communication equipment is provided by the " Performat " fully-electric combined typewriter and tape punching machine, developed by Lorenz in co-operation with Triumph-Werke, Nürnberg A.G. The " Performat " utilizes the international five-hole teleprinter code, and permits paper tapes to be punched simultaneously with the normal typing of reports, orders, ledger entries, accounts, etc. The punched tape can then be fed, as and when required, into teleprinter, accounting machine, machine tool control systems, etc.

● **Collins Radio Company** has brought out a new transistorized DC power supply unit (without moving parts) to replace the 416N-1 dynamotor-type supply now used with the 51R-1, 2 and 3 communication/navigation receivers. Designated 416N-6, the new power supply unit has the same output as its predecessors (245 V ; 130 mA), but an input of only 1.56 amp (2.75 V) and an efficiency of 73 % compared with the earlier 50 %. Dimensions : 4 ½" × 5" × 5 ½" ; weight 4.75 lb.

● **Philips'** Hamburg office has announced the production of a new high-intensity flash tube, with a loading of 52 watt/seconds every half-second, which is especially suitable for installations demanding a low-frequency sequence of high-intensity flashes such as airport approach systems. By employment of a reflector a maximum intensity of 30 million candle-power can be obtained from the tube. For an approach lighting system a line of flashing lamps is installed ahead of the runway, along the centre line; the pilot is given the impression of a tracer of light, repeated every half second, pointing to the commencement and direction of the runway.

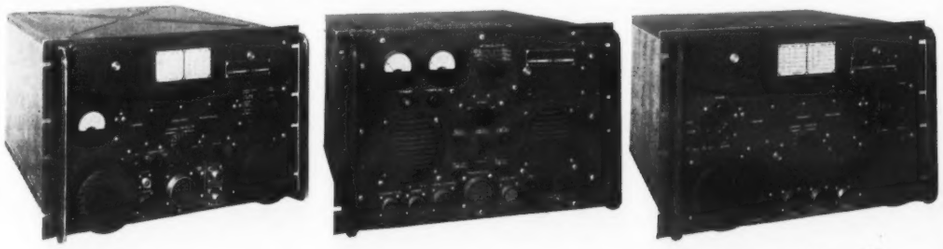
● **The Radio Corporation of America** announces the new AVR-200 marker receiver, which is fully transistorized, contains no relays, tubes or moving parts, is housed in a short 1/4 ATR rack and weighs 59 ozs. Power required 0.3 amps at 28 volts DC ; sensitivity 200 microvolts ; output, aural (500 ohm) or visual (3-lamp system) ; input impedance 50 ohm.

● **The Plessey Company** has introduced a new range of " Metallux " resistors, constructed of nickel-chrome (90%-10%) metal film on a cylindrical ceramic former. Bonded sintered silver ends provide terminals. Ratings range from 1/8 to 115 watts and values from 0.1 ohm to 1 Megohm with tolerances from 10 % down to 1 %, frequency range from 0 to 1,000 Mc/s ; ambient temperature operation —65° to +230°C ; a temperature coefficient of less than 20 parts per million per degree Centigrade can be achieved.

● **Nortronics Division of Northrop Aircraft Inc.** has announced the development of a device for automatic electronic star tracking during broad daylight. The equipment, which has been successfully demonstrated during more than 200 cross-country flight tesst, will be a key element in automatic guidance systems for both terrestrial and interplanetary guided missiles ; it may be utilized either as part of an automatic celestial navigation system or as a monitoring instrument for inertial navigation systems.

● **Murphy Radio Ltd.** has developed a civil version of the *Rebecca Mk. 8* military airborne equipment designated Mk. 8B, and providing range and heading facilities in conjunction with any standard transponder beacon in the 220 Mc/s band. The equipment consists of a TR332 transmitter-receiver unit and B333 junction box installed in the equipment bay, and the CU334 control unit and M341 meter unit fitted in the pilot's position. The aerial system (not illustrated) includes separate omnidirectional transmitting and receiving aerials. The equipment transmits VHF pulses on any one of eight spot frequencies in the 200-235 Mc/s band, to trigger a fixed-point ground transponder (*Eureka*). Pulse travel time gives distance, and the two left/right heading aerials permit a radial course to the *Eureka* station to be flown. The operating distance in conjunction with the *Eureka Mk.* 7 transponder beacon is up to 200 n.m. depending on altitude. *Rebecca Mk.* 8B is to be fitted to BOAC's *Comet* 4s.

● **Ateliers de Constructions Electriques de Charleroi :** ACEC is producing the AN/GRC-27 UHF R/T and W/T ground station equipment for ground-to-air communications, under licence from Collins Radio Company of Cedar Rapids. The equipment comprises a T-217 A/GR transmitter (left picture), the MD 129 A/GR modulator and power supply unit (centre), and a R-278 B/GR receiver (right), together with two wide-band antennas (AT-197/GR and AS-505 B/GR), operating in the 225-400 kc/s frequency band and providing 1,750 crystal-controlled channels with 100 kc/s separation. Ten transmitter and receiver frequencies can be pre-selected. Transmitter power is 100 W and the receiver sensitivity is 6 microvolts (signal to noise ratio 10 db ; 1,000 c/s modulation frequency, 30 % modulation depth). The same receiver is utilized in an AN/CRD-6 D/F equipment in conjunction with the T-216/GR signal generator. For this employment the receiver has a special output for a detected 30 c/s modulation signal which is produced by rotation of the directional receiver antenna (1,800 r.p.m.). The bearing angle is determined by phase comparison of the detected 30 c/s signal against a reference. The several units are all designed for installation in 19-inch standard racks.



Space and Missile Projects Either Side of the Atlantic

Now that the tension created by the appearance of the Soviet Union's *Sputnik I* satellite has eased, a more realistic approach is being made to the United States' satellite and space vehicle projects. The government, research and industry have now found common ground on which to tackle the most pressing and urgent problems, and on which far-reaching civil and military development programmes are currently being set up.

The present situation, as it affects the United States missile and space vehicle efforts, is outlined below. Not to be overlooked, however, is the fact that Great Britain is also active in this field, and is energetically developing her own rocket missile. The British IRBM discussed at the end of this article will certainly give new impetus to space research in that country.

U.S. Civilian Space Agency Plan

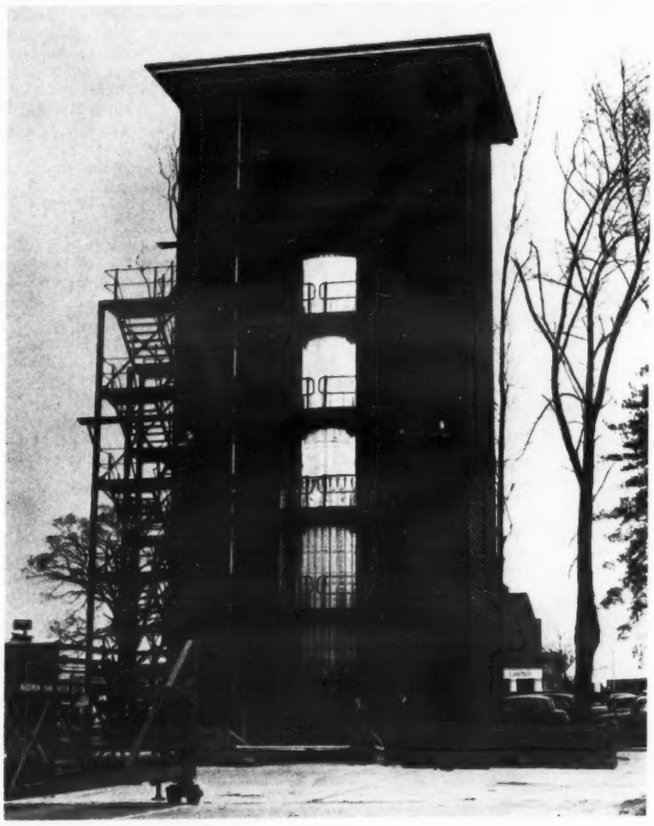
The House of Representatives Astronautics and Space Exploration Committee has unanimously approved the President's proposal to establish a *civilian* National Aeronautics and Space Agency (NASA) [1]. The bill will now be submitted for the approval of the full House and of the Senate.

Under the Committee bill, which largely conforms to the President's proposal, the new agency will absorb the National Advisory Committee for Aeronautics (NACA) which will then cease to exist as an independent research organization. The Director of NASA, and his deputy, will both be appointed by the President, subject to Senate confirmation. At the same time the President will also appoint a 17-man aeronautics and space advisory board, comprised of nine representatives of the Government and eight members from outside the Government; at least three Government members will be from the Defense Department. The board's decisions will not be binding on the Administration. The director of NASA will also attend National Security Council meetings, when invited by the President.

Other details of the bill are: 1—The creation of a joint Congressional space committee, similar to the Joint Atomic Energy Committee, with the chairmanship rotating between the House and Senate every two years; 2—Stipulation that NASA shall disclose all information not specifically classified under security restrictions; 3—NASA to appoint 200 scientists and engineers at average salaries of $19,000 per year, a larger number than for any other Government agency. Even the Pentagon itself is only authorised to appoint a total of 120 employees at the $19,000 level. With these increased salaries the Government is obviously trying to encourage NACA's present scientific and engineering personnel to stay on with the new agency, and to attract additional skilled personnel for the many new tasks now planned.

[1] Cf. *Interavia* No. 5, 1958, page 461.

A prototype of the British IRBM on the newly-constructed test stand at de Havilland Aircraft Co.'s. Hatfield plant. The test stand illustrated is for checking the propellant supply and other systems.



ARPA Satellite Programme

While the new civil agency, NASA, as yet exists only on paper, the military agency ARPA (Advanced Research Projects Agency) has already announced its weapons and space plans. Of the various projects listed in *Interavia* No. 3, 1958, priority is being given to the development of unmanned moon rockets and military observation satellites. ARPA has already approved five moon vehicle projects (three by the USAF, and two U.S. Army projects), as well as a further three U.S. Army satellite programmes with the *Jupiter* IRBM and *Jupiter C* rockets as first stages. Further details of some of these projects are reported on page 594 of this issue. In this connection some surprise has been created by the announcement of a $2,850,000 contract awarded to California Institute of Technology's Jet Propulsion Laboratory for development work on the new *Juno* space vehicle project, under which it is planned to launch a moon rocket before the end of 1958.

Meanwhile Dr. Herbert York, ARPA's Chief Scientist, has disclosed plans to continue the launching of satellites for scientific research purposes beyond the programme now planned for the International Geophysical Year which ends on December 31st, 1958. York has suggested a launching rate of one satellite every one to two months. One of the forthcoming Army shots with the *Jupiter C* will employ a novel technique to launch a 12-foot inflatable aluminium-foil balloon into orbit; a small rocket located in the nose of the future *Explorer* will be timed to fire when the vehicle reaches its apogee, thus extending the apogee of the balloon satellite to about 800 miles. Following burnout of the small auxiliary rocket, a pressurized gas bottle will inflate a bladder forcing the tightly-packed aluminium sphere from the vehicle; the balloon satellite will contain a small battery-powered transmitter to permit Minitrack measurement of the orbit to be compared with optical data. It is expected that the sphere will remain in orbit for about 40 days if the prescribed perigee is established, and it will provide precise measurements of air density at extreme altitudes.

British IRBM Progress

The British aircraft industry continues to make quiet but steady progress in the development of its own IRBM, with which static tests are scheduled to start very soon. Prime contractor and coordinating authority for the design and construction of the first British IRBM is de Havilland Propellers Ltd., with Rolls-Royce Ltd., de Havilland Aircraft Company Ltd. and Sperry Gyroscope Ltd. as associated main contractors. Details of the weapon have not yet been released but, according to reports from London, this is believed to be a two or three-stage device, with a launching weight between 70 and 75 tons, an inertial guidance system, and 2,500-3,000 mile range. It has also been stated that the approx. 70-foot long missile will be fired from underground launchers.

A joint statement issued by the four companies says that extensive facilities for the initial testing of the various components and systems are being established at a number of centres in the United Kingdom. One of these is at de Havilland's main Hatfield plant and another, to be managed by Rolls-Royce, is being built at Spadeadam Waste in Cumberland. Full firing trials will be carried out at the Woomera rocket range in Australia.

Book Reviews

1957-1958 Aircraft Year Book, Thirty-ninth Annual Edition. Official publication of the Aircraft Industries Association, Inc. Published by American Aviation Publications, Inc., Washington, D.C., 1958 (English, 432 pages).

If the reviewer merely assured readers that the AIA's Aircraft Year Book is a highly instructive, reliable handbook of U.S. aviation in all its branches—aircraft industry, air transportation, military aviation, aviation policies—he would do it less than justice. As a general rule there is nothing duller than year books . . . and the more reliable they are, the drier reading they make. But from the first page to the last the present book is written in so lively a style that it will be read in full by even the most blasé of initiates. The tone is set by the brief one-page introduction, whose anonymous author easily succeeds in winning the reader's interest in his subject, namely 365 days of aviation history. There follows a picture report on the year's records and other aviation events (in which the initial failures of American satellite launchings are by no means whitewashed). The next chapter, on the industry, covers all companies from Beech to Vertol, Aerojet-General to Westinghouse, Aeronca to Wyman-Gordon. Air Force, Army, Navy, NACA, the airlines, all get their fair share. Pages 220 to 351 contain photographs, three-view drawings and details of American aircraft, engines and missiles. Finally, there is a history of U.S. aviation from January 16th, 1784 (when Benjamin Franklin proposed that airborne troops be used in conjunction with balloons) to December 12th, 1957 (world speed record set up by Major Adrian Drew in a McDonnell F-101A), and a day-by-day chronology for 1957.

Hats off to the American aviation writers who are neither bored themselves nor bore their readers ! He.

Three Steps to Victory. By Sir Robert Watson-Watt. Odhams Press Limited, London, 1957 (English, 480 pages, numerous illustrations, price 30 shillings).

The father of radar, whose pioneering work brought his countrymen victory in the Battle of Britain and paved the way to greater safety for flying throughout the world, renders his account in this witty, lively book. An account of his own life and work, and an account of the radar pioneers. Marconi, Bowen, Cockcroft, Tizard, all the scientists who were involved directly or indirectly in the early work . . . all pass in review, and Sir Robert generously and fully discusses the work of his predecessors on which his success was based. To take only one especially striking example: as early as 1900 Nikola Tesla wrote in " Century Magazine ": " Stationary waves . . . mean something more than telegraphy without wires to any distance . . . For instance, by their use we may produce at will, from a sending station, an electrical effect in any particular region of the globe; we may determine the relative position or course of a moving object, such as a vessel at sea, the distance travelled by the same, or its speed."

Needless to say, the epoch-making achievements of Sir Robert are in no way diminished by these " revelations ". For the rest, his book shows that, alongside his other accomplishments, he is a skilled and cultured writer. He.

Naissance d'une Ligne. By Daniel de Bois-Juzan. Pierre Amiot, Paris, 1958 (French, 227 pages, numerous photographs).

Maurice Noguès, the hero of this book, won for himself through his life work and his death so well-defined a place in the history of civil aviation that the reviewer must not forestall the author. The " line " whose birth and growth are graphically described in this book is Air France's route to the Far East . . . and in more general terms the company's whole overseas operations, for which Noguès gave his life. Well worth reading! He.

Photographies aériennes et aménagement du territoire By A. Burger, Dunod, Paris, 1957 (French, 136 pages, 105 illustrations, price 1,700 French francs).

This book has been presented to the University of Paris Town Planning Institute, where it deservedly aroused great interest. Aerial photography is an extremely valuable aid in all town and country planning problems, as photographs can be taken in such a way (angle, lighting conditions, etc.) as to bring out special features of the terrain. Together with the conventional methods used by the experts, aerial photographs, of which the author gives a number of interpretation examples, can also be of value to economists, sociologists and population experts. The book can also be used with profit by teachers seeking a means of enlivening their lessons. So.

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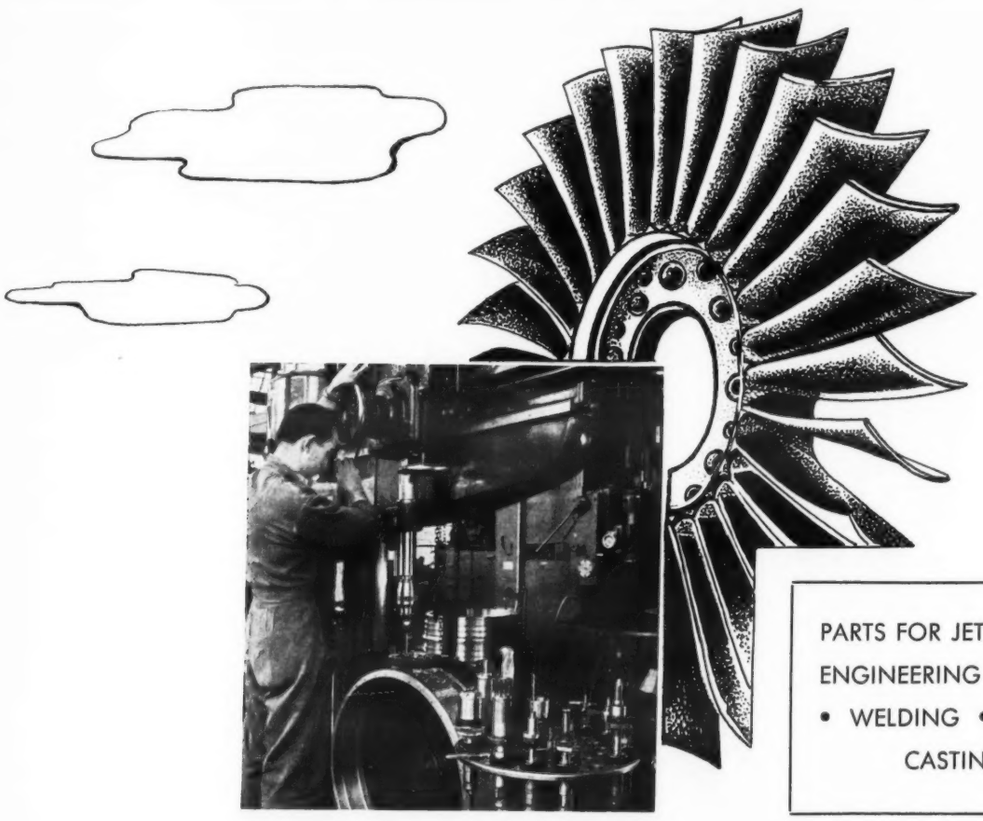

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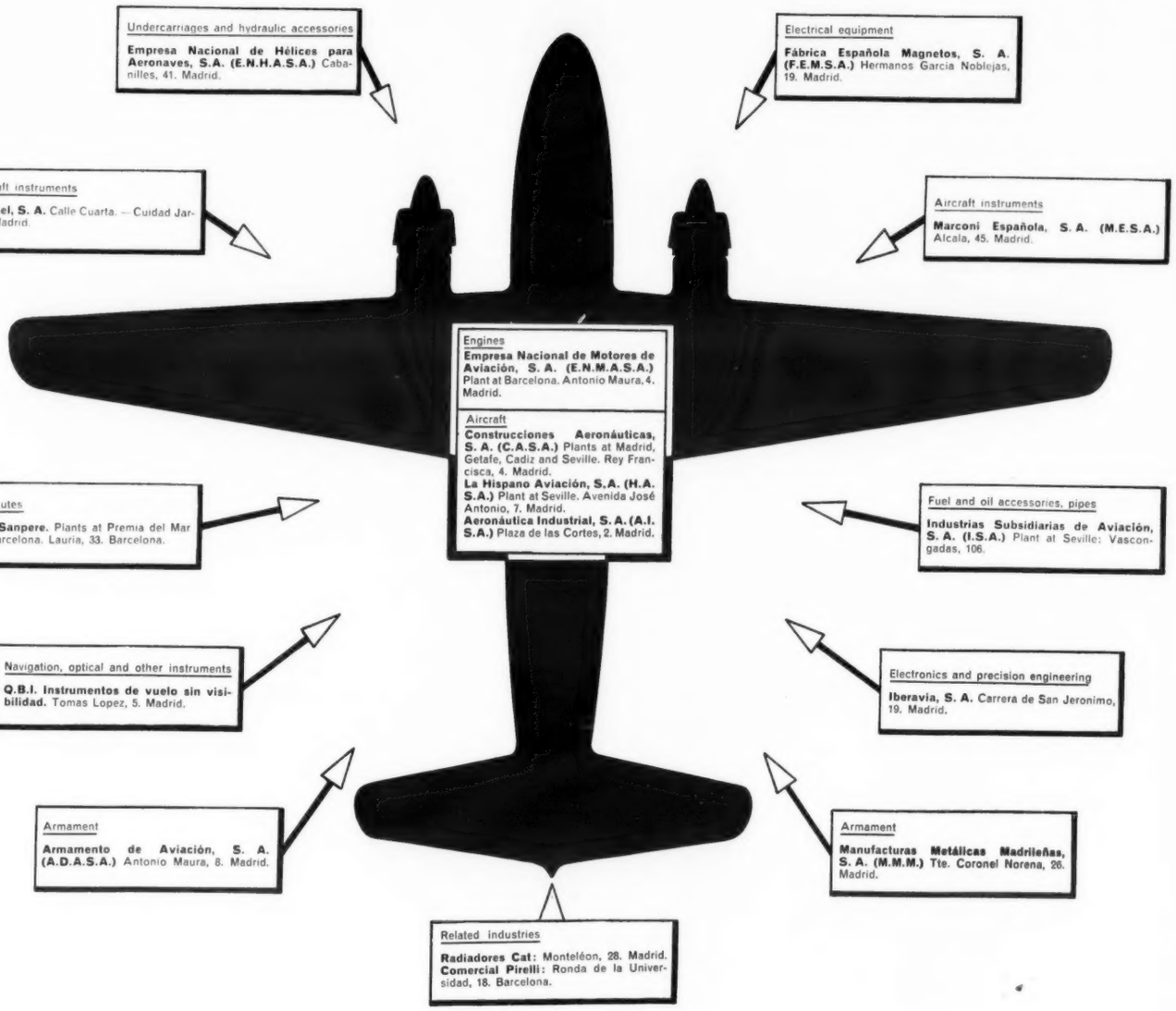
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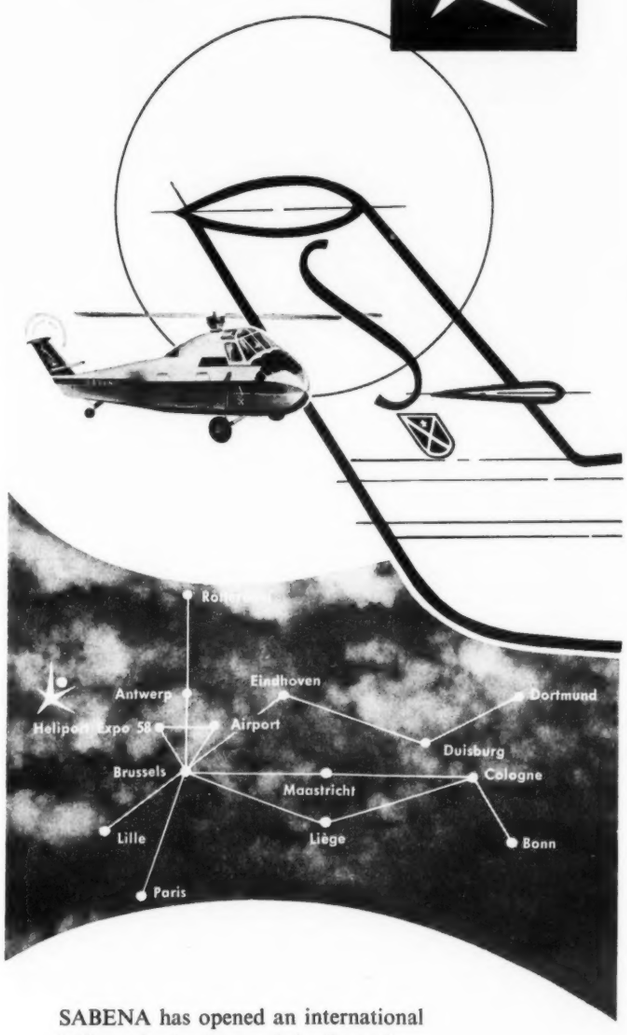

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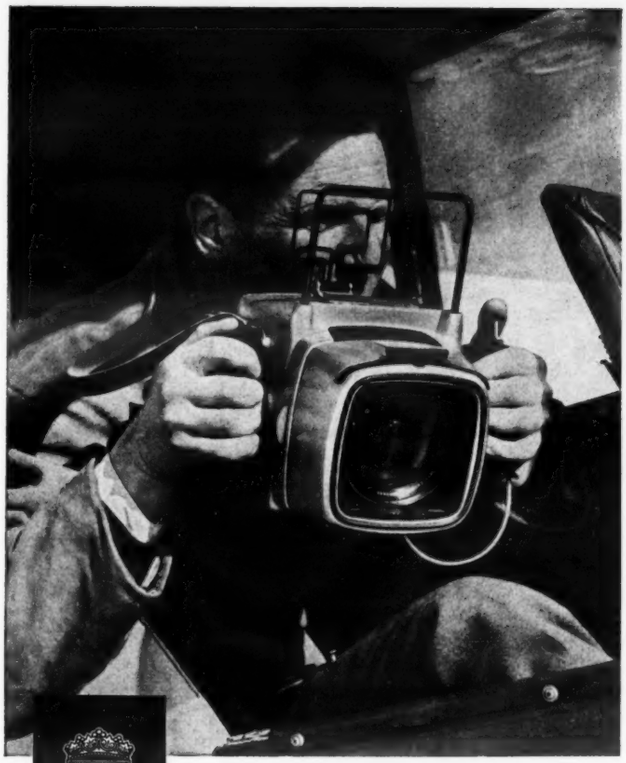

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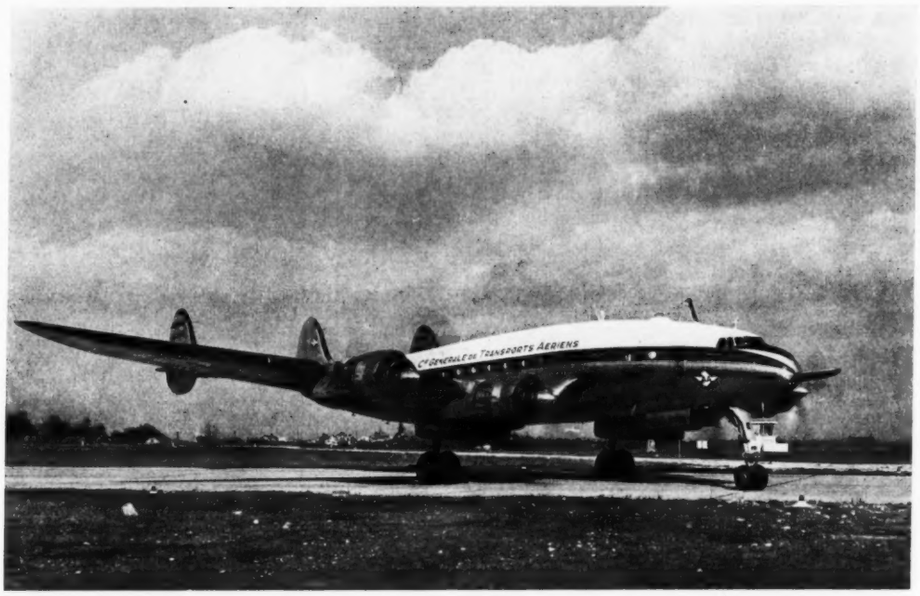

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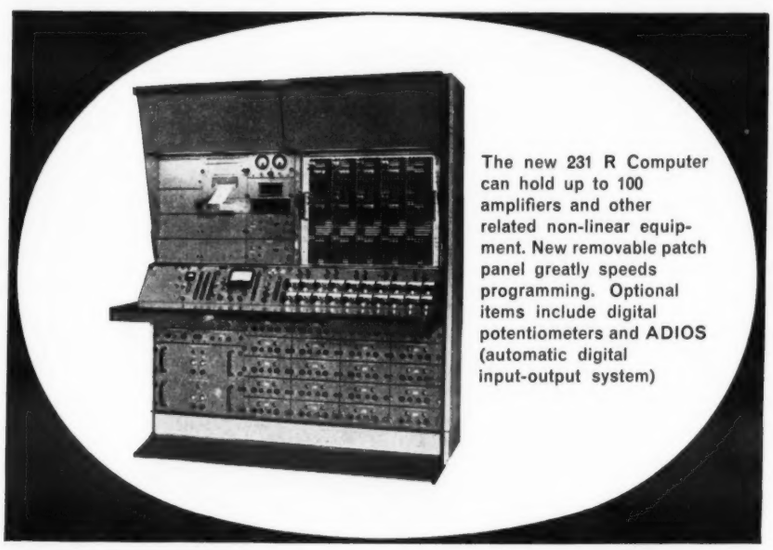

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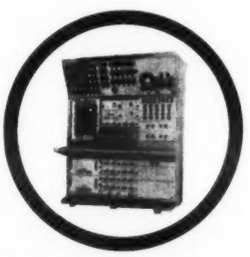

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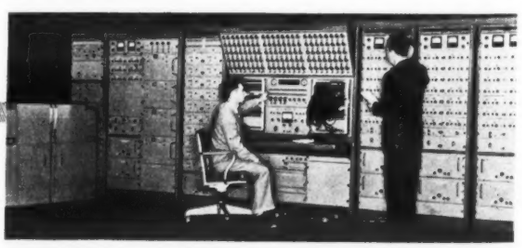

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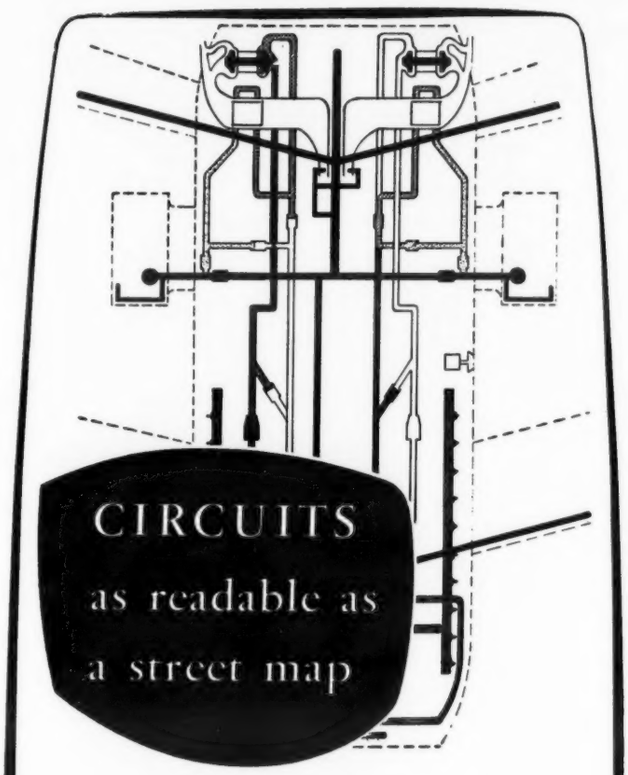

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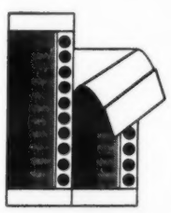

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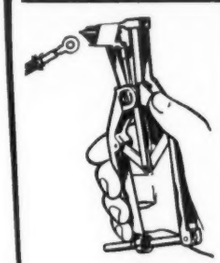

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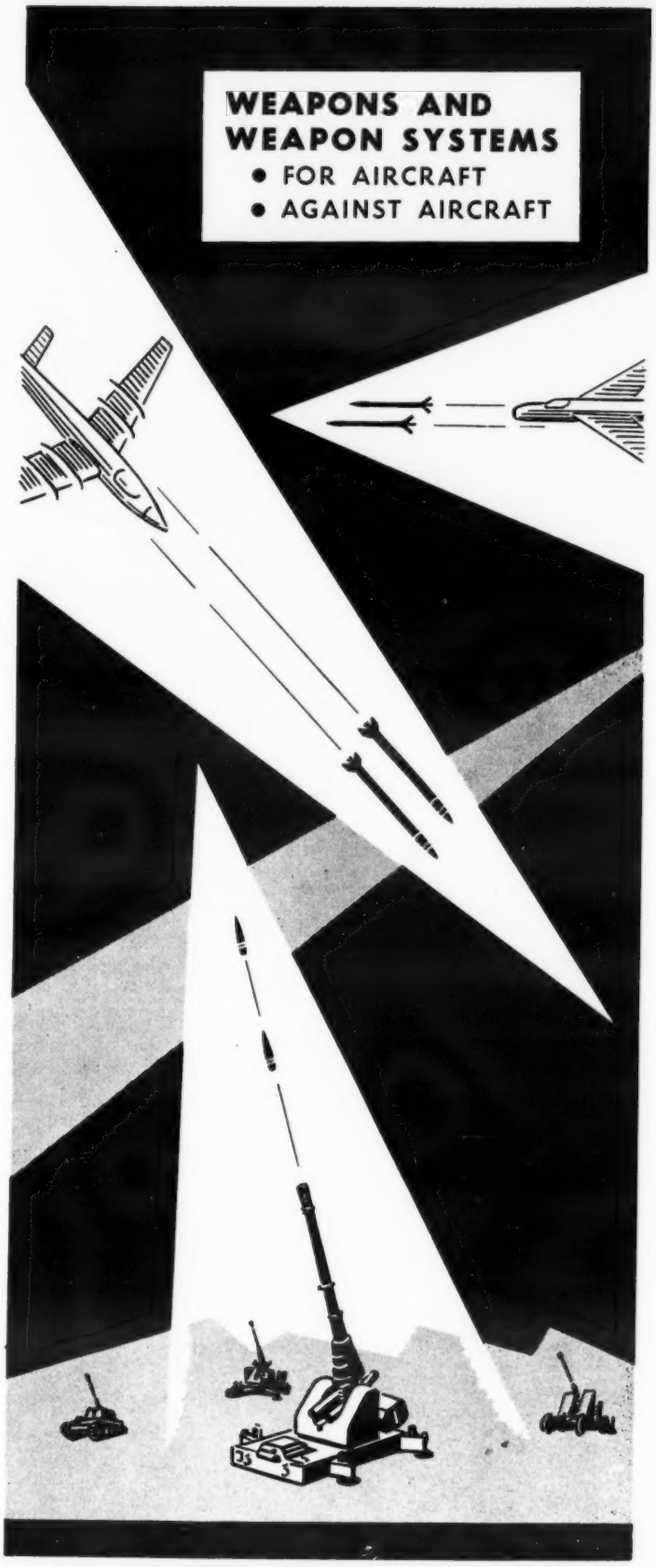

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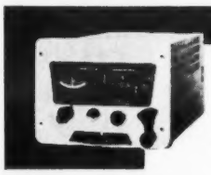

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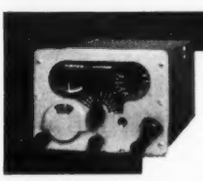

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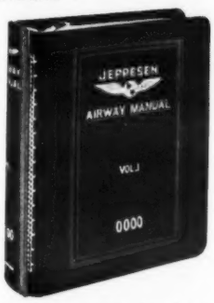

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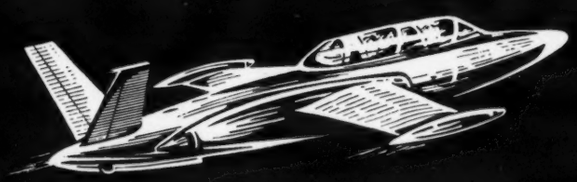

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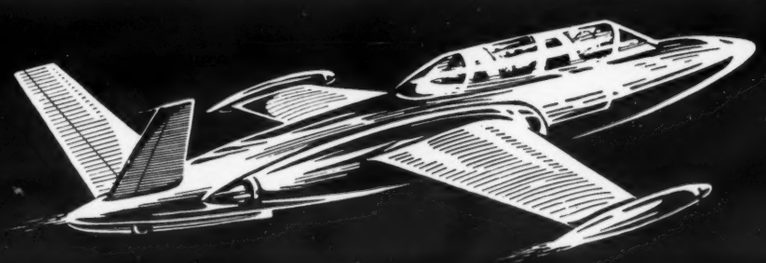

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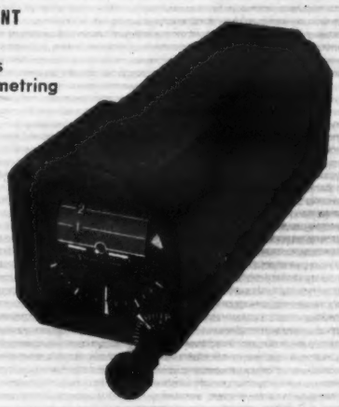

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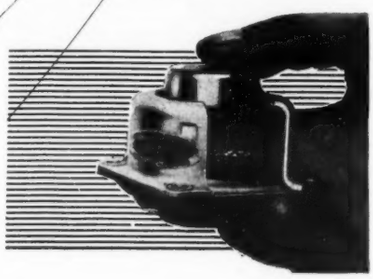

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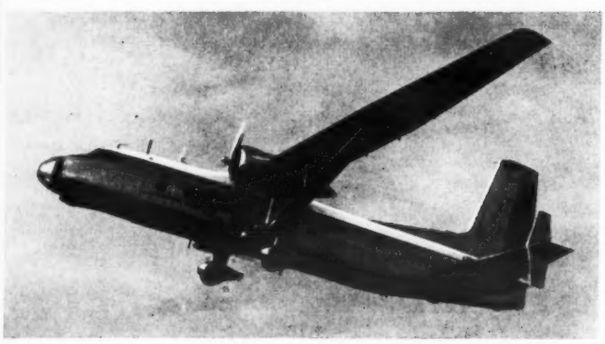

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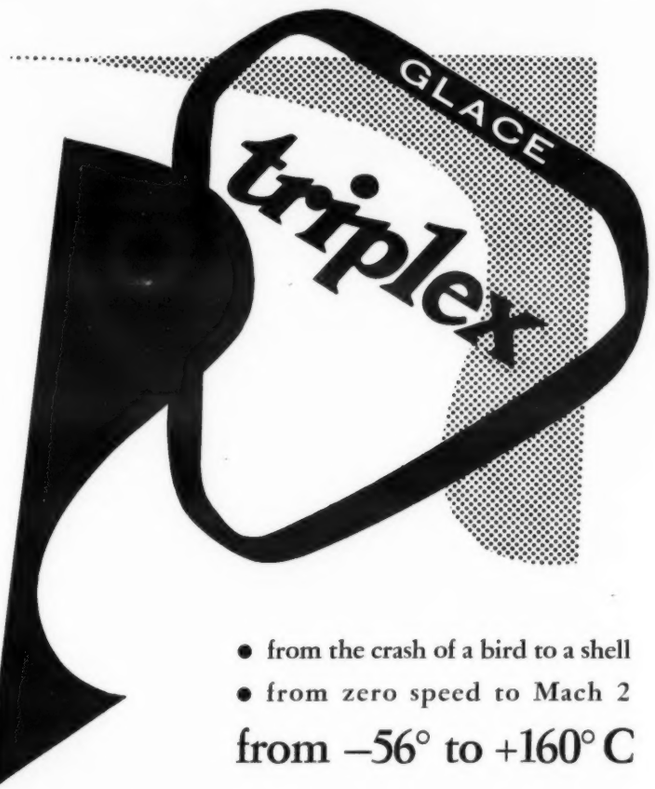

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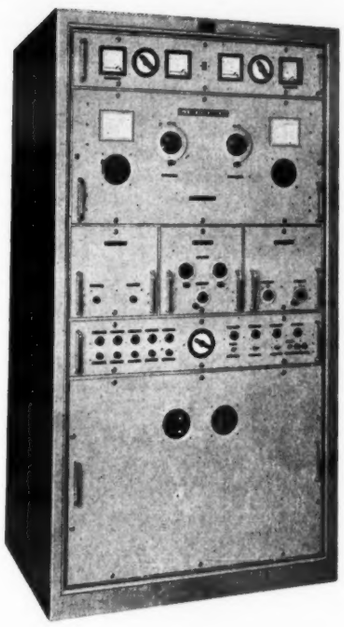

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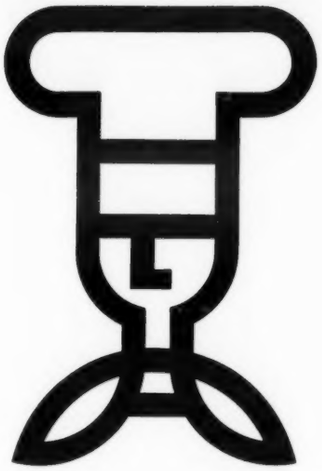

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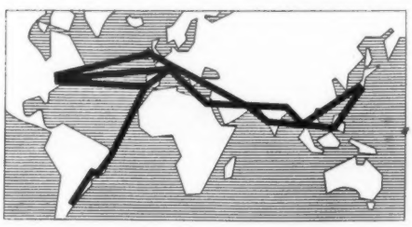

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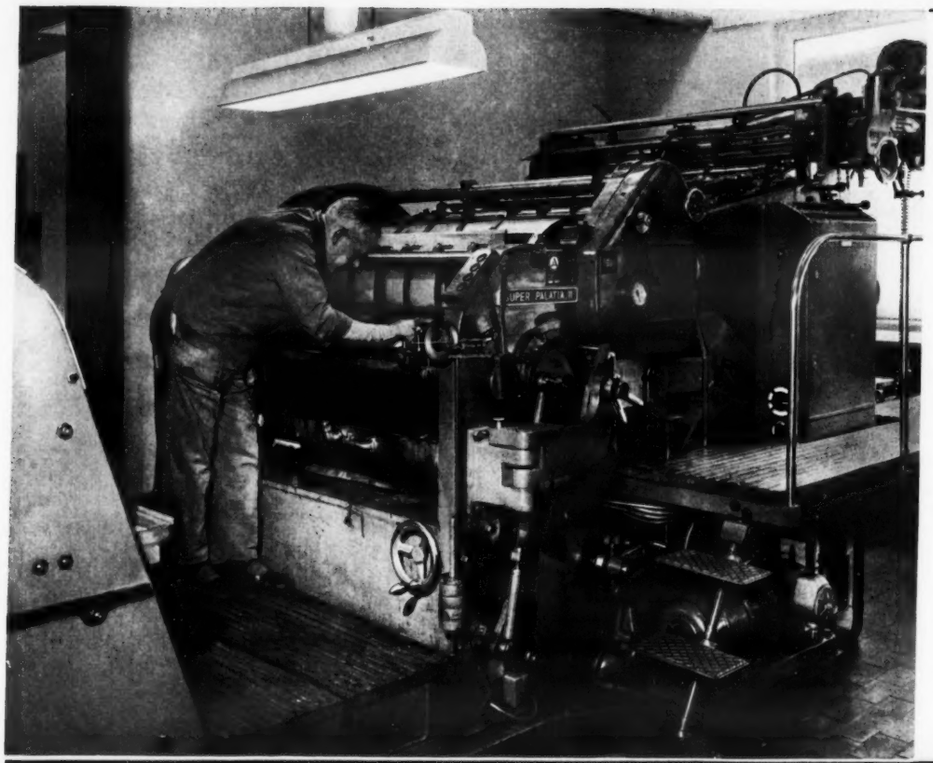

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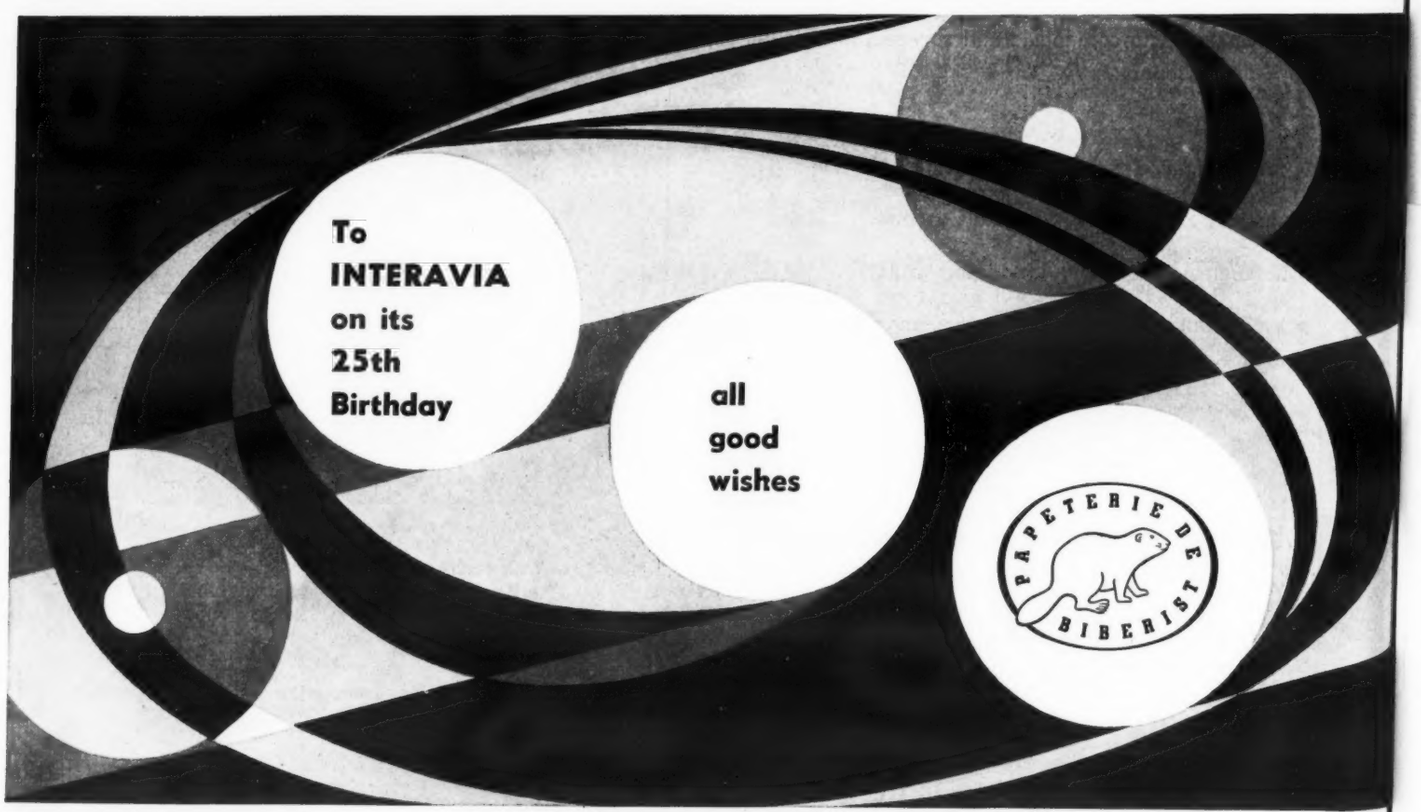

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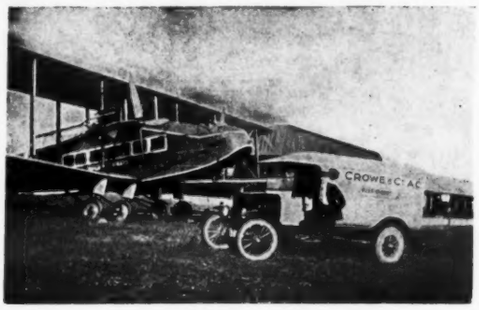

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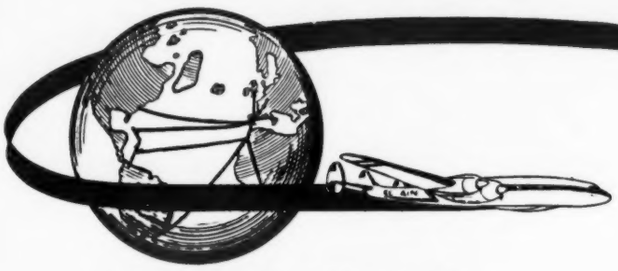

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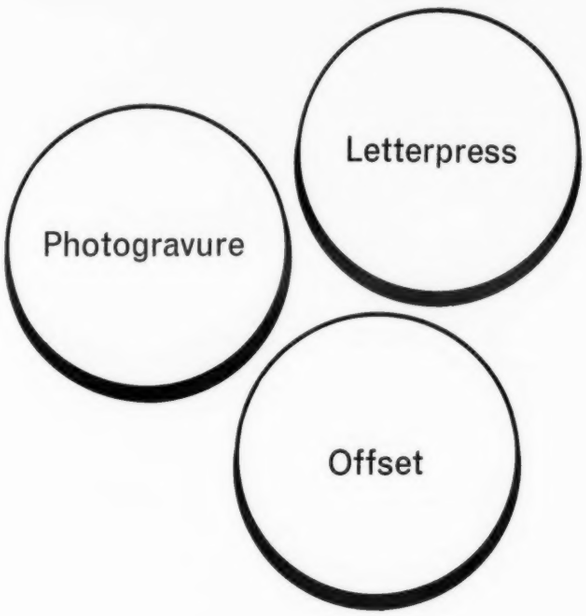

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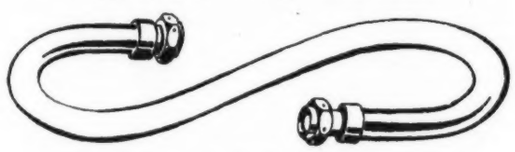

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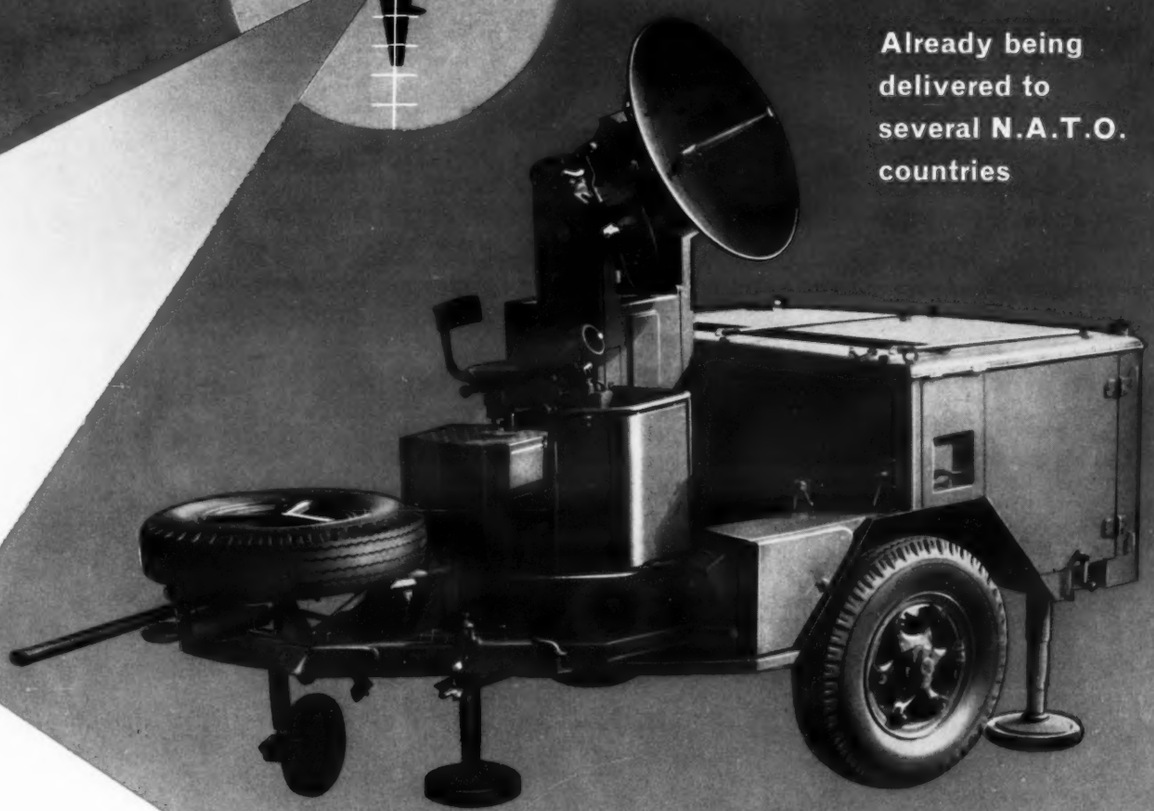

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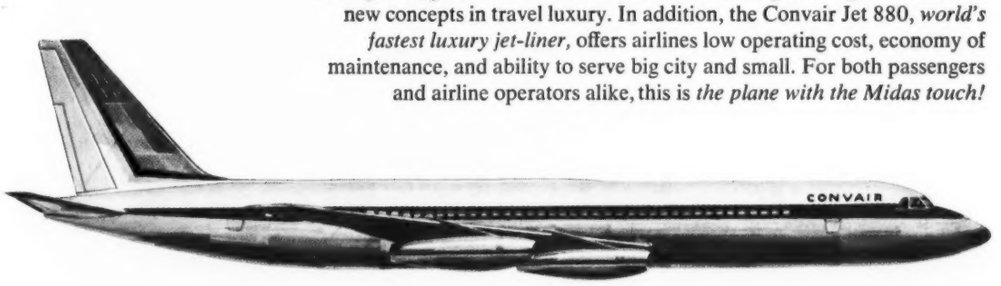

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